

Francisco Castillo · Korina Monoso

# Managing Information Technology

*Second Edition*



Springer

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## Reviews

“Information Technology (IT) is very pervasive nowadays and a necessary domain but at the same time, there is a lack of sound practical knowledge and a gap between the theory and the efficient management of these services and technology.

In his book, Castillo addresses the management of the IT domain from a very practical and objective perspective. Personal experience and specific skills are present along the whole list of chapters.

The book is definitely instructive, very practical and a good help for people developing IT responsibilities in their respective companies and organizations.”

—Professor Joan Cabestany, *Universitat Politècnica de Catalunya*

“A superb effort in compiling into a single source a practical approach to the management of IT, leaving far behind the traditional approach of using methodological recipes. “Managing Information Technology” is an essential book which brings a fresh and complete vision to all that a CIO needs to know for the proper management of operations and projects. Castillo’s book is a valuable introduction to this subject matter, and a fast way for familiarizing oneself with its key aspects.”

—Alberto Ariza, *PMP (Partner, Strategyco)*

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## Preface

In 2011 I started my career as CIO of a large Philippine company, during that time, the first thing I wanted to do was to set the organization right, in terms of its structure, as well as processes, as this would set the pace for the many years to follow. Got it wrong, and I would have to live with that mistake for many years. What was clear to me at that time is that there were two very different components in IT: strategy, which is long term; and tactical and operational concerns, which is short-term. One cannot do without the other, and I was expected to address both, knowing in fact that I only had a very limited honeymoon period in my hands. I could not address long-term without fixing the operational issues first, and yet, strategy would always be in the back of my mind.

The other very apparent difference for me was that of managing operations vs. projects, and I wondered if what many companies were doing at that time was right: that of mixing resources to do both. So I did what I usually always do when unsure, which is to research to support some of my suspicions, and I came out relatively empty handed. Yes, I was already aware at that time of some of the industry standards, but these were high level and difficult to interpret, and, worst of all, I did not have any time to actually execute them. And so, I did the next thing I would usually do, which was to roll-up my sleeves, put on my thinking cap, and try to dissect and understand what really would make sense. This was the start of my practical experience that is reflected in this book.

The book starts with just that: discussing the ideal/suggested table of organization in an IT department, and the rationale of why I have reached such a conclusion. It separates distinctly strategy from day-to-day operations, as well as projects from operations, the two most important functions of a CIO. It goes on, discussing the most pressing need: that of managing operations in Chap. 4. This chapter is based on some of the best industry standards and their nomenclature in the field, with a difference: I try to explain exactly what each party is to do, and how it should be done at a very practical level. The theory exists out there, but how to make it practical is a different matter. For in operations, once the structure is correct, the next challenge is how to handle tickets (e.g. requests and incidences), which are the basic day-to-day of the operations team. This means how to record changes, escalate them, address them, test them, release them, and possibly roll them back if necessary. This brings us to the typical lifecycle for operations' services: Planning &

Design—Release—Maintain—Retire. Each of these phases has its own distinct aspects which should be monitored and managed, including availability and capacity management. Operations are also linked to IT strategy, and we discuss when this strategy translates to a project, or to operational changes, and if the former, how these project(s) link to operations.

Chapter 5 discusses projects, the other lifeline of IT, and in this chapter we make a marked distinction between the methodologies to be used in projects with that to be used in operations. It is not recommended to mix these, and as such discuss IT project management in detail. We first start with the basic project management principles, but zero in on the way these general principles are to be used in IT projects. IT projects are perhaps one of the most difficult projects to manage because they deal only with intangibles. Furthermore, the people that usually define the success of a project are the end-users which the CIO has no control of, but who must influence using some special people skills (so-called change management). We spend time discussing some of the most critical parts of IT projects: analysis, design, the cut-over period, the go-live and support phases. Each of these requires its own particular documentation and techniques. Included in this chapter is a discussion on some of the most failure prone components of a project: customizations, testing and people change management.

Documentation is discussed at length for both operations and projects, because adapting to the waterfall standard of project methodology, it is really the lifeline for IT to be sustainable, as well as projects transferable to operations.

What I also learned during my stint as CIO was that the cut-over from projects to operations was many times the most critical. People from these two distinct teams did not like to talk to one another, but is necessary for the sustainability of the service that has just been designed. Likewise I searched for material and found very little on this subject, so I decided to develop our own guidelines and procedures, these are shared in Chap. 6. Starting with a discussion on the typical different environments (development, testing, training, production), and then aspects which seem like common sense and are usually taken for granted, but are actually very much project-specific: backup and restore procedures, release management procedures, data migration, data quality, interfaces, and most importantly, roles and responsibilities of operations, project personnel and third parties during the go-live and support phase. We have come up with a checklist of tasks to be undertaken before the go-live to increase its probability of success, which have been refined throughout the years, the basis for this chapter.

Once operations and projects are in place and the fire-fighting is finished, the next thought that should be in a CIO's mind is how to sustain this, as well as how to minimize issues. Fire-fighting and addressing issues should consist of less than 20% of one's time, but in order for that to happen, the proper governance should be put in place, which is discussed in Chap. 7. We first start on how company governance is related to IT governance, and how these in turn are related to policy, and international standards such as ISO20000, ISO9001. Operations governance is actually embedded as part of the processes by which operations works with, but project

governance is somewhat more “loose”, so that the chapter delves mainly on project governance. Governance in projects refers to what must be ensured by the Project Manager, and once more, is based on the minimum required documentation that must be produced at different phases of a project. Documentation standardization is in fact the key in making projects successful, as this is the tool necessary to monitor status, and manage accordingly. We discuss the proposed four basic documents for any project: Project plan, issue registry, request registry and project deliverables checklist. We also discuss the roles and responsibilities of different personnel in an IT project, because oftentimes, projects also fail because of unrealistic expectations in the project team, or mismatch between expected and actual skills and roles.

Chapter 8 is an overview on one of the hottest topics in IT project management methodologies today: Agile-Scrum. In this new edition, we go into more details of this methodology, especially since there has been a resurgence in custom-developed applications.

Operations, projects and governance, how does all this glue together? If the number of projects and the breadth of operations are huge, it is suggested to have ad-hoc portfolio managers that will oversee these according to specialty. If not, the ultimate portfolio manager is the CIO herself. From the point of view of the portfolio manager, he is interested in knowing how his operations and projects are performing, but would not be interested in the details unless he needs to dive into them (e.g. there are issues to be resolved). As such, he defines the governance for his set of operations and projects so that he can get accurate and timely information from which to act. One of his main tasks as well is to think beyond the projects and see if the projects are still meaningful or not to the company, and if new projects or operational initiatives need to be defined in order to align IT to company strategy. The portfolio management as discussed in the last chapter, can be defined as a cycle once more: planning and design, assessment and communicating, and portfolio rebalancing. On top of this cycle is portfolio governance by which the different portfolio components are to comply with, as well as his monitoring and control tools.

Chapter 10 is an altogether new chapter; in the first edition I kept silent on IT Security, but today, especially after the pandemic, it is too hard to ignore. It serves as an introduction to IT Security, so that the reader can then find his way among everything written in this field, which is quite extensive and confusing.

Well, this is all for now. I have written this book to hopefully bridge the gap which I think still exists today, so that anyone who is in the same situation I was when I started as CIO would have a much easier time.

Lastly, anyone interested in receiving a copy of my templates in MS office format, please contact me at my email below and I will gladly reply.

Many thanks and good luck with all your IT operations!

Paranaque, Philippines

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I would like to acknowledge the many people that supported me while preparing this book, especially my parents who made all of this possible, my staff in Maynilad that worked with me through the years (too many to mention here), as well as my bosses Mon Fernandez and Manny Pangilinan.

Most of all, I wish to thank my wife Rina and daughter Linda, my main inspirations, who heartened me and had all the patience in supporting me when I wrote this book during many weekends and holidays.

Lastly, I would like to dedicate this book to Filipino engineers and IT professionals, who bring innovation, order, and process in a country not particularly famous for it.

### **Francisco Castillo**

My deepest gratitude to my boss and the main author of this book, Francisco Castillo, for giving me the opportunity to co-write. The learning experiences at work and how we have put all these concepts and principles into actual practice under his leadership and guidance have given me the confidence and the motivation to write and to share to all our readers.

To my husband Nerf and my kids Khalil and Kylie, thank you for the steadfast love, support, and patience as I completed this special assignment. All of you, together with *Mama(+)* and *Papa(+)*, are always in my heart in everything I do.

### **Korina Monoso**

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# Acronyms Used in the Book

AC	Actual Cost	Amount of money spent in a project at a particular point in time
AM	Application Management	O&M team in charge of maintaining software applications both for new requests and incidences
BPO	Business Process Owner	A role taken by an end-user which signifies he/she makes decisions on process changes
CAB	Change Approval Board	A body which (dis)approves of any CI changes that as per policy necessitates its approval
CI	Configuration Item	A basic concept used in ITSM which refers to any parameter or configuration that affects overall performance of a system
CI/CD	Continuous Integration/ Continuous Delivery	Among the key principles of DevOps, characterized by frequent integration and (re-) packaging into the main code of multiple, simultaneous development
CMDB	Configuration Mgt Database	The repository of current Configuration Items used for all systems in production
COTS	Commercial off-the-shelf software	Refers to pre-built software packages that require minimal programming for them to be used
CPI	Cost Performance index	=EV/AC
CR	Change Request	A project term used to signify an item out of scope from the original contract scope
CRM	Customer Relationship Management	Application or application module for handling and facilitating a company's customer relationship, support and interaction
DBA	Database Administrator	Technical Management personnel in charge of the upkeep of databases
DEV	Development	Environment where all configurations emanate from
DevOps	Development-Operations	Collaboration between Development and O&M Team in a continuous plan-design-develop-test-release-operate-monitor cycle

DevSecOps	Development-Security-Operations	Involves the IT Security team to cover the security perspective in the DevOps collaboration
DR	Disaster Recovery	
DWH	Datawarehouse	A repository of data, commonly used for reporting and analysis purposes
ERD	Entity Relationship Diagram	High-level logical data model
ECAB	Emergency CAB	The same as CAB, but called in for an emergency, rush decision
ERP	Enterprise Resource Planning	A large computer system with multiple modules spanning across a company's functions and processes
ETL	Extract-Transform-Load	A batch program that runs for the purpose of extracting data from one system and loading it to another
EUT	End-user Training	training of the end-users on the new system/application
EV	Earned Value	a concept used in projects which measures the value delivered by the project at a point in time
FCR	First Call Resolution	When a request or incidence is resolved by the Service Desk without necessitating further escalation
FRICEW	Forms-Reports-Integrations-Conversions-Enhancements-Workflows	Is the abbreviation used to describe different forms of customizations in a COTS
FS	Field Support	Personnel assigned to physically troubleshoot and repair end-user devices, part of O&M
II	IT Infrastructure	Department in charge of all IT infrastructure projects, dotted responsibility over infrastructure in production
IS	Information Systems	Department in charge of all new applications projects
ITOM	IT Operations Mgt	Under the O&M team, responsible for facilities management, as well as overseeing batch production processes
ITSM	IT Service Management	
KB	Knowledge Base	A document indicating in detail how an issue was resolved, including its root cause
MVP	Minimum Viable Product	A software product already has the minimum functionalities to be of value, rendering it ready for shipping or release
O&M	Operation and Maintenance	The team in charge of operating and maintaining the different systems and infrastructure already in production
OLA	Operational Level Agreement	An agreement sitting below the SLA which is usually more stringent
Ops	Operations	Synonymous with O&M

PDCA	Plan-Do-Check-Act	A continuous improvement cycle, also referred to as Deming cycle
PM	Project Manager	Overall in charge in the delivery of a particular project assigned to him/her
PR	Purchase Requisition	
PROD	Production	Environment where the system is in production, meaning is live and being used by endusers to transact
PV	Planned Value	the original baseline in a project
QA	Quality Assurance	Environment where testing is conducted
SD	Service Desk	Personnel receiving requests and incidences in O&M, is usually their Single Point of Contact (SPOC)
SECCAB	Security CAB	A separate CAB which handles security decisions
SI	System Integrator	An external party in charge of delivering an entire working solution
SLA	Service Level Agreement	A written agreement stipulating the level of service required in operating
SPI	Scheduled Performance index	=EV/PV
SysAd	System Administrator	Technical Management personnel in charge of operating and maintaining servers
TM	Technical Management	O&M team in charge of infrastructure
TO	Table of Organization	Diagram showing hierarchy and reporting structure
TOR	Terms of Reference	A document used in tendering which specifies all requirements
UAT	User Acceptance Test	Testing undertaken by the end-users before going live
US	User Support	O&M team in charge of support to end-users, including their devices
VIP	Very Important Person	Indicates a person which requires more attention in handling



# Introduction

# 1

When speaking of IT functions, two distinct ones come to mind: the day-to-day Operations and Maintenance (what I will refer to as O&M), and Projects. O&M, as the name implies, deals with maintaining all of the IT services available, keeping things running, and dealing with the request for changes that are raised by the different users of the IT systems, whether these are purely internal and within the company organization, or external customers. Projects, as implied by the name, refer to new deployments of IT services in the form of systems, applications and infrastructure. A CIO is expected to handle both, and to know a bit of everything: software, processes, user change management, servers, networking, programming, etc. and he is also expected to know how to handle operations, and handle projects.

In truth, handling operations is very different from handling projects, and the methodologies used and best practices for each differ considerably. Both IT and Project Management standards exist out there, but as standards, are high level and fail to tell really how you can practically apply these. Concretely, if one is to setup an IT organization, immediate concerns would come to mind: how to structure the organization, what are their roles and responsibilities, how to divide and distribute work, how and when to specialize, and what are the management tools that need to be setup for these.

In this book I have attempted to do just that, take the fundamental principles of ITSM and best practices in project management, and come up with a single, seamless reference for IT Managers and Professionals. I have tried to make it as practical as possible, talking about how to actually apply these principles based on my experience in the industry. Making these practical is the first and most import step, but is not enough. Long-term sustainability requires that these principles also be framed in governance policies and procedures, and so I also discuss what aspects should necessarily be captured in these policies and procedures.



*In this chapter we touch on some very basic aspects that are at the heart of all IT organizations. Firstly, the difference between operations and projects, in terms of the way they operate and the methodologies they use. We look at the roles that typical IT personnel (according to position) would play for both projects and operations, and make a clear distinction on when they should have a role, and when they shouldn't.*

*Next we touch on how strategy differs from operations, not only at the conceptual level, but what this actually means in the day to day. As such, we address a common pitfall many organizations succumb to, that of mixing strategy with operations, and that of mixing roles and responsibilities of projects with operations, this sets the groundwork for the discussion on what could be an optimal table of organization for the next chapter.*

*We then touch on the three basic components of all IT operations and projects: systems, processes and people, define each, as these will be encountered over and over again in all the chapters, in different forms.*

---

## 2.1 Projects vs. Operations, Strategy vs. Operations

Projects and Operations & Maintenance (O&M) are the two distinct, yet necessary functions in any IT Organization. Projects have distinct properties as compared to operations. First and foremost, projects have a very distinct start and finish, while operations are continuous in nature, and this is true no matter what industry it is being applied on. Because of this, the ways projects are managed are quite distinct from operations, and yet, that interface between projects and operations is a crucial link for projects to be ultimately successful, and an area which commonly fails.

Projects also have very distinct phases, in which they initiate-plan-execute and close, while operations are continuous, and have no distinct phases within them. IT Project outputs may lead to additional services, which will then need to be supported by O&M thereafter, and will form part of Operations' service catalog. O&M can also

**Table 2.1** Projects vs. Operations comparison

Projects	Operations
• Creates its own charter, organization and goals	• Semi-permanent charter, organization and goals
• Purpose of change	• Purpose of status quo
• Unique product or service	• Pre-defined and approved product or service
• Heterogeneous team	• Homogeneous teams
• Definite start-definite end	• Ongoing (continuous)
• Progressively elaborated process deliverables	• Fully-known process deliverables

**Table 2.2** Roles and responsibilities for Operations and Projects

CIO (overall)	Operations	Projects
Strategy	Head for operations	Portfolio managers (Information systems head, IT infrastructure head)
Delivery functions	O&M team	Project manager
IT security	IT security team	IT security team

request and initiate a project as part of its effort to continuously improve (PDCA), yet the treatment of this project will follow that of standard projects.

Some more differences between the two are shown in Table 2.1.

Though as will be discussed, project governance has its own particular policies and guidelines, every project is different, so that each project has its own charter, organization and goals, its main purpose is in fact to *CHANGE* something, while that of operations is more of status-quo, with its semi-permanent (though improvements do exist) charter, organization and overall goals. Projects are put up to produce a very concrete IT service, while operations is mainly to support and operate an existing, pre-defined service that is part of its service catalog. Projects have a definite timeline, after which they cease to exist, while operations never end.

A very important characteristic is that deliverables or outputs of a project are progressively elaborated, something which is very important and will be discussed in detail under scope management, and which means, that unlike Operations, the final detailed outputs are not clear from the very beginning but are progressively defined and refined in terms of detail as the project progresses.

Just from some of these differences, it becomes apparent that the way Projects are to be handled differs considerably from that of Operations.

On the other hand, strategic decisions need to be made for both Projects and Operations, many times, these cannot be made separately (especially so for infrastructure). Table 2.2 shows a typical matrix of roles in the organization and their corresponding responsibilities.

Strategy consists of planning and initiating projects or other initiatives that either improves the service to the end users or provide additional services to them. It must be aligned with the overall company focus and direction, and must provide some

**Table 2.3** Roles in Projects and O&M

Responsible area/function	O&M	Projects
Overall management	Operations head, CIO	PM, Portfolio Mgr., CIO
Applications	Application Management (AM)	Business Analysts
Programming	Developers (under AM)	Developers
Operations	IT Operations Management (ITOM)	n/a
User Support, service desk	User Support (US), service desk	n/a
Technical infrastructure	Technical Management (TM)	Technical Support
IT security	IT security (ITSec)	IT security (ITSec)

concrete benefit or address concrete requirements needed by the company. Generally speaking, a new initiative should:

- Increase revenue
- Decrease operational cost
- Improve customer service
- Address legal and regulatory requirements; or
- Minimize risk

These are of course very broad, and it is up to the CIO, Head for Operations, as well as the Heads for the Portfolios to align and translate business requirements from the organization to concrete initiatives that need to be started in IT. The portfolio managers depicted above may be several, depending on the size and structure of the organization. At the very least, it requires one to handle new applications (Head for Information Systems), and another to handle hardware and infrastructure (Head for IT Infrastructure). For larger organizations, IS and II roles may be further broken down into separate portfolios. These personnel are the key in conceptualizing, proposing and designing new projects. They also are responsible for all the different projects that fall within their portfolio, as well as applying governance over the different projects and overseeing PMs under them. IT Security should in general be unified and seen as a whole, covering both projects and operations.

The Operations Head's strategic initiatives mainly focus on how to improve operations by reducing costs, making it more efficient, resilient and minimizing risk and in some case how to cater to the different regulatory and legal requirements. These improvements may be small in scope and breadth, so that they can be handled directly by the O&M team, or may be treated as a separate project altogether. In case of the latter, it then falls under one of the portfolio manager's responsibility and is treated much like any other project.

Table 2.3 details further the roles for O&M and projects.

As one may appreciate, there are counterparts in projects for the roles in O&M, except for those roles that really only appear once the system is in operations: IT Operations Management (ITOM) and User Support (US). The first does not exist because they are in charge of regularly executing programs that produce outputs for

the end-users. As a project is by nature not yet operating, there are no end-users yet to speak of, thus there is no role equivalent for ITOM. The same holds true for User Support.

A portfolio manager may have O&M as part of his portfolio, and this is true as well for the CIO. Not only is he overall head for the IT Department and drives strategy, he is also the overall portfolio manager which also contains O&M as part of his portfolio. Some other organizations do not differentiate their IT structure between projects and operations, but rather, mix these according to functional area. This has its own advantages and disadvantages, some of which are discussed in Chap. 3; however in general, this is not a best practice. Main advantage of a functional organization is that if the Portfolio Manager has been long with the organization, he may have a deep functional knowledge of the portfolio he is handling, disadvantage is that he will have to learn how to apply two distinct methodologies, and learn how and when to switch from one to the other. This setup may be appropriate for very large organizations which require very specialized functional expertise and regularly have update projects in that functional area, but other than that, it is better off to separate projects from operational responsibility.

The problem in having both an Operations and a Project hat at the practical level is that since both methodologies are distinct, the person does not easily “switch” mentality. Take for example a role in which the team lead for the sales system is getting a large number of tickets due to incidences in the sales process which has been now declared obsolete due to circumstances, while at the same time, management is pushing some new sales modules which need to be developed and implemented in the next month. Although the team lead has all the necessary resources: business analysts familiar with the application, developers, technical architect, he has a problem in allocating resources for each, and making sure that the project is monitored in accordance with Project Management best practices, while tickets are replied on time and with full details and documentation as also required by Operations best practices.

On the other hand, having separate teams has one major challenge that of transferring projects into O&M, what I refer to as cut-over (also referred to as hand-over, transitioning, etc.), and requires special procedures so as to guarantee its success.

Finally, there is a role which is indeed shared by both Operations and Projects, that of IT Security (ITSec). The main concern of IT Security is to ensure that all applications and systems in production are safeguarded against hacking and unauthorized access (more on this in Chap. 10), and this is mainly an operational concern; however, if security is just enforced when systems are placed in production, it is in fact too late, so that even while the project is being conceptualized, designed, and built the IT Security team should provide oversight, guidance, and audit.

It is important to remember that success or failure of projects and initiatives is to be seen from the business point of view, meaning, whether the project has delivered the intended benefit to the business. Oftentimes, IT Departments have a narrow vision of success: project completed on time, project completed within budget, and

yet, due to other factors, the delivered service is not actively used by the users. Common issues include:

- People change management issues
- Project does not really reflect the needs of the users
- Project does not reflect the need of the business
- The project is already obsolete due to the new direction taken by the business

The first point is taken further in its respective section; the second refers to scope management, while the last two are the main job of the portfolio manager, and is explained in its respective section.

Take for example this typical, real-life situation. A big corporation is given a huge budget to modernize its IT systems, starting with its reporting system. Having seen several vendor presentations, they settle for one of the fastest, most sophisticated Data storage, reporting system and corresponding hardware. The project is awarded and started, making sure all the software components are correctly installed and the architecture at par with the best performing data storage systems in the world, however, the consultants and IT manage the whole process from a technology point of view, having in-depth user requirements defined as an afterthought. In fact, they apply “Agile” techniques in which the users are presented with reports and dashboards and asked for their concurrence, to which they do; however, they fail to go into the details of the different indicators being presented and how they are calculated. The project hits a major snag when the first set of deliverables is presented to the users, which they reject because they do not concur in the way several KPIs are being measured. The project team is at a loss and after tweaking and re-tweaking the reports, gives up after 1 year, when the IT Manager is fired and the whole project shelved.

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## 2.2 Systems, Processes and People

It is commonly said that IT is made-up of three main components: systems, processes, and people. Unfortunately, all three are intangibles, so they are very hard to define and manage.

- *Systems*: refers to the applications, infrastructure and other assets which execute and automate particular business functions.
- *Processes*: refers to the way in which the systems are set-up to conduct a particular business function
- *People*: refers to the IT Department’s staff, as well as all end-users making use of the systems in conducting their normal business operations

Each of these three needs to be managed by IT, and in degree of increasing complexity (normally) are systems, processes, and people. To explain each by means of an example, let us take a common application, say a financial application

that handles General Ledger (GL), Accounts Payable (AP), and Accounts Receivables (AR):

- System—in this case would refer to the specific brand and version of the financial package bought
- Process—would refer to the configuration and setup of the different modules in the system. For example, for Accounts Payables (AP), it would refer as to how the Accounts Payable processes these accounts and payments, in step by step fashion and in accordance with how business is conducted using the system
- People—refers to IT and the finance department using the application

For any application to succeed, all three need to be addressed, for example by:

- *System*: purchasing a brand and version that meets the end-user requirements in finance (this means, that the system is *CAPABLE* of delivering the desired functionality)
- *Process*: the specific configurations on the system so that it meets the end-user requirements. These requirements need to be defined in detail so that the configurations match these requirements. If the system chosen must have the capability to deliver the functionalities, the actual process design and configuration of the system are what *enable* and *deliver* the desired functionality. A system delivered with a certain process in place is referred to as an application.
- *People*: even though the right system was chosen and the right process mapped into it, it is still useless if the people do not understand it and do not use the application correctly, unless otherwise, the success of the application is doomed.

Systems are bought from a vendor, processes are configured into the system by the consulting and System Integration companies contracted, and people are trained both by the System Integrator and by IT in the use of the application. The reason why people are usually the most difficult component is that firstly, it is the users that need to define the process they need. This poses several problems, for one, the users may not really know or cannot really express what they need. Secondly, assuming that the consulting company is very experienced in eliciting their requirements, the users may not be able/may not want to dedicate sufficient time to this endeavor. This may be especially true during the testing phase, as it must be the end-users to test and verify whether the system adheres to the specifications that they require. Finally, there is the people change management aspect. People change management refers to the process of managing change in an organization, in our case, brought about by a new application or new process to be released. People are inherently resistant to change, it causes insecurity and fear in them, and the natural reaction is push-back. Push-back manifests itself in making it difficult for the change to succeed, delaying approvals, continuously raising issues, ignoring meetings, and may manifest in many more ways. It may also be unintentional and the fault of the IT Department, in not explaining enough (not just about the application, but what It means for the business), not enough training, or focusing too much in transactional training rather

than disseminating to the users the rationale and know-how on how the processes are designed to work.

In summary, the IT Department needs a strange combination of many skills: technical, operations, project management, processes, Technical Management, and people skills. It is for this reason that many IT initiatives fail; putting all these skills together in a concerted fashion is a very difficult task indeed. Furthermore, structure and procedures make a lot of difference in ensuring success, the other being experience, something which is not taught nor written in any book (but hopefully addressed, even if partially, by this book).

Take the following problematic examples:

**Example 1:**

A new sales system is bought by IT as requested by the Sales Department. The system is selected based on demos and features shown by the vendor which were appreciated by the end-users, however, when the project starts, the Sales Dept. is too busy to dedicate time in sitting it out with IT and the System Integrator (SI) in defining the correct sales processes, sending instead some very junior staff which together with IT, define the blueprint. Upon going live, the system does not work in accordance with what sales wants and the whole application is junked.

**Example 2:**

A new ERP (Enterprise Resource Planning) system is bought as higher management has decided to “modernize” without clearly understanding what this means or implies. The services for implementing the system are bid out as a turn-key contract and awarded to an experienced SI. IT however is inexperienced with this type of system, and most especially, the industry best practices in terms of the processes covered. In the course of the project, some hard decisions are to be made, including streamlining the invoice payment process from a purely manual process, in which currently payments are approved by means of an approval form physically signed by different authorized signatories, to three-way matching in which everything is paperless. Three-way matching means matching an invoice received from the vendor with the actual Purchase Order released to him, and the acceptance of the goods upon delivery (Goods Receipt-GR), which guarantees that payment takes effect only if the three “match”. The SI presents this process, however, the users are very resistant to the change, and IT being unknowledgeable, is unable to defend the proposed process change. As the SI has a project to finish, and sensing the mounting resistance, conveniently accedes to the request of not implementing three-way matching to avoid lengthy discussion and conflict, proposing instead a change request for customizing the payment process based on the users’ liking. This situation is a losing proposition for the customer in not utilizing the power of an industry best practice, and for IT, in customizing a very standard process in the ERP, which will get back to them eventually.



*Parting from the introduction of concepts in Chap. 2, we delve into what is probably the most crucial decision a CIO and IT Manager must make when setting-up his organization: defining the optimal structure. This is crucial as it is the basic underlying layer for all IT processes henceforth, and is usually very difficult to change in the middle of the game.*

*The basic precept in this chapter is that operations and projects have different methodologies, and objectives altogether so that they must in fact be separated and handled by two different teams with totally different techniques. In getting to that conclusion, we first do a review of what a functional organization typically looks like, how a project organization would in contrast look like, and since most IT organizations conduct both operations and projects, propose the ideal combined structure. We then identify the lead personnel positions in this structure based on their intended roles and responsibilities.*

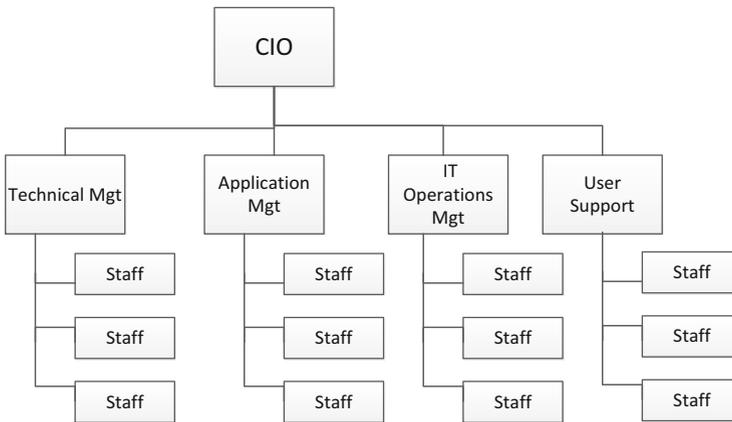
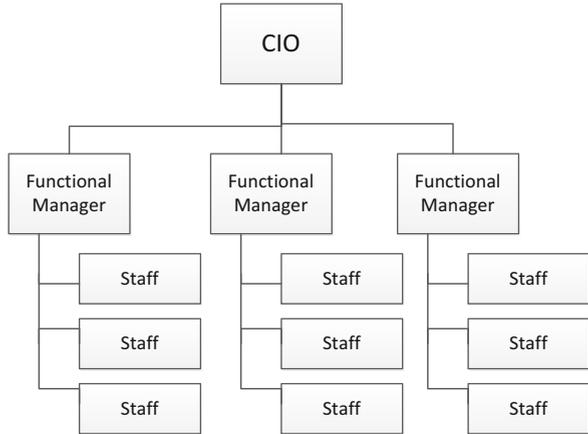
From the point of view of operations vs. projects, there are several variations on the type of organizations employed. Typical operations-focused organizations have a very rigid hierarchy, based mainly on the functional roles for each position under IT as shown in Fig. 3.1.

Functional managers would be concerned with their particular area of responsibility, whether this would be a series of applications, or organized based on the type a skills they handle. A typical IT operations-focused organization would look like that shown in Fig. 3.2.

The role and function of each of these teams is explained further in the sections under O&M, however, to briefly describe:

- *Technical Management*—is in charge of the general upkeep of all infrastructure components. This includes network, storage, servers' resources, as well as technical components of the different software, typically the technical implementation of the applications, databases, and operating systems.

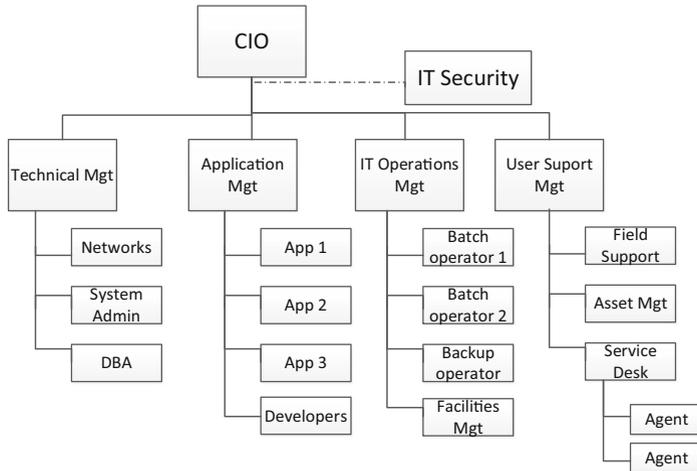
**Fig. 3.1** Functional organizational Structure



**Fig. 3.2** Typical IT functional structure

- *Application Management*—is in charge of updating and maintaining all application configurations. They typically modify these based on incidences and request requirements. The difference with the involvement of TM in the applications is that AM handles everything that affects processes and their behavior, while TM handles all technical aspects.
- *IT Operations Management*—is responsible for the day to day management and maintenance of the IT Infrastructure, batch processes and other repetitive functions needed to deliver the necessary IT services to the end-users
- *User Support*—is the interface between IT and the users, so that users need not know anybody else but the US personnel interfacing with them. It is in charge of first level support to the users and attempts at their resolution. It handles all requests and incidences reported by end-users.

If we now further define the table of organization one level down, we then have the TO shown in Fig. 3.3.

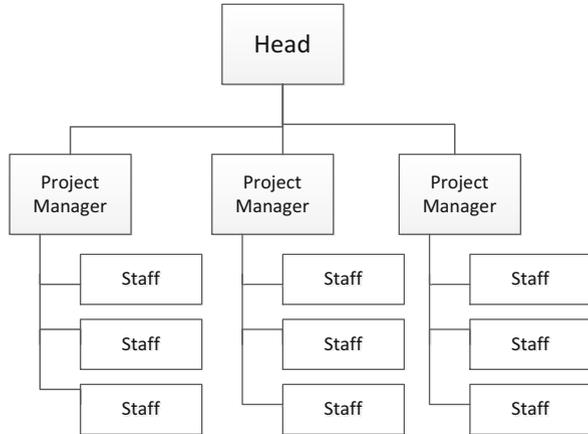


**Fig. 3.3** Typical IT functional structure with details for each team

Technical Management has its different distinct teams in charge of networks, system administration, and Database Administration. The Application Management team will have business analysts specialized in the different applications and typically a pool of developers (programmers) in charge of customizations. The Business Analysts may not be broken down into specialized groups but may also be a pool, which can service different applications, depending on their skill sets. IT Operations Management will have different batch operator teams that run and monitor the different batch processes, and the facilities management team in charge of the regular upkeep of IT facilities such as data center, common facilities and the like. User Support is further broken down to Field Support, Asset Management, and Service Desk. Service Desk is manned by agents who receive and process the requests and incidences from the users, and are the users’ single point of contact. They man the Service Desk system and attempt to address the request or resolve the customer’s issue immediately, but if unable will then escalate this to the proper team. Field support refers to personnel that distinct from the rest of the teams, may actually travel to where the user is, in attempting to service a request or incident. They commonly address requests and issues related to the endpoint devices, including repairs. The reason for placing field support under User Support is that although it may seem that it is more technical and would belong to Technical Management, most requests and incidences are generated directly from the service desk by end-users and need close coordination with the service desk personnel. Asset Management here refers to the reception, storage and disposal of IT assets, which is under User Support as the bulk of these items correspond to end-user requested or assigned devices. IT Security which appears here, is in charge of the overall security of all the organization’s IT assets.

On the other end of the spectrum is the project-oriented organization as shown in Fig. 3.4.

**Fig. 3.4** Typical project-oriented structure



Wherein each manager is focused toward his particular project(s), there is no operational focus whatsoever. This is typically found in consulting companies, system integrators, and engineering companies which have a very lean internal operational function (sales, administration, marketing, etc.). As most IT organizations need a mix of both, the question is what would be the proper Table of Organization (TO) for an all-encompassing IT organization? My recommended approach is to separate the project organization from the operations organization, giving the operational organization a structure which follows the IT Operational structure above, while the project organization is focused towards a pure project setup, similar to what is shown in this last TO. The project heads would have a more strategic role, in coming up with medium and long-term plans and translating, these into actual projects that are aligned with the company's overall (changing) strategy. These project heads would be managing the portfolio of projects and continuously aligning them to the company strategy. An example of this organization is shown in Fig. 3.5.

In this organization, the head for Information Systems is in charge of strategy and new projects related to software applications, while the Head for IT infrastructure is his counterpart for infrastructure, which includes all hardware and technology components. The IT infrastructure Head must coordinate very closely with the Technical Management team under O&M due to their interrelationship, and definitely all projects must be closely coordinated between Projects and O&M for turn-over.

The philosophy of the company in undertaking projects should also be considered. If projects are fully contracted out, then each of the PMs will interface with each vendor PM and have no personnel under it. If projects are done in-house, then the PM will have to "borrow" resources from the line organization either full-time or part-time. This is only possible if the company's IT headcount is considerable, so that the O&M team can afford to lend to the project teams, but is rarely the case. Part-time borrowing has the problem mentioned during the book's introduction, in which the personnel will lack focus and would be confused as to the methodology to use. In

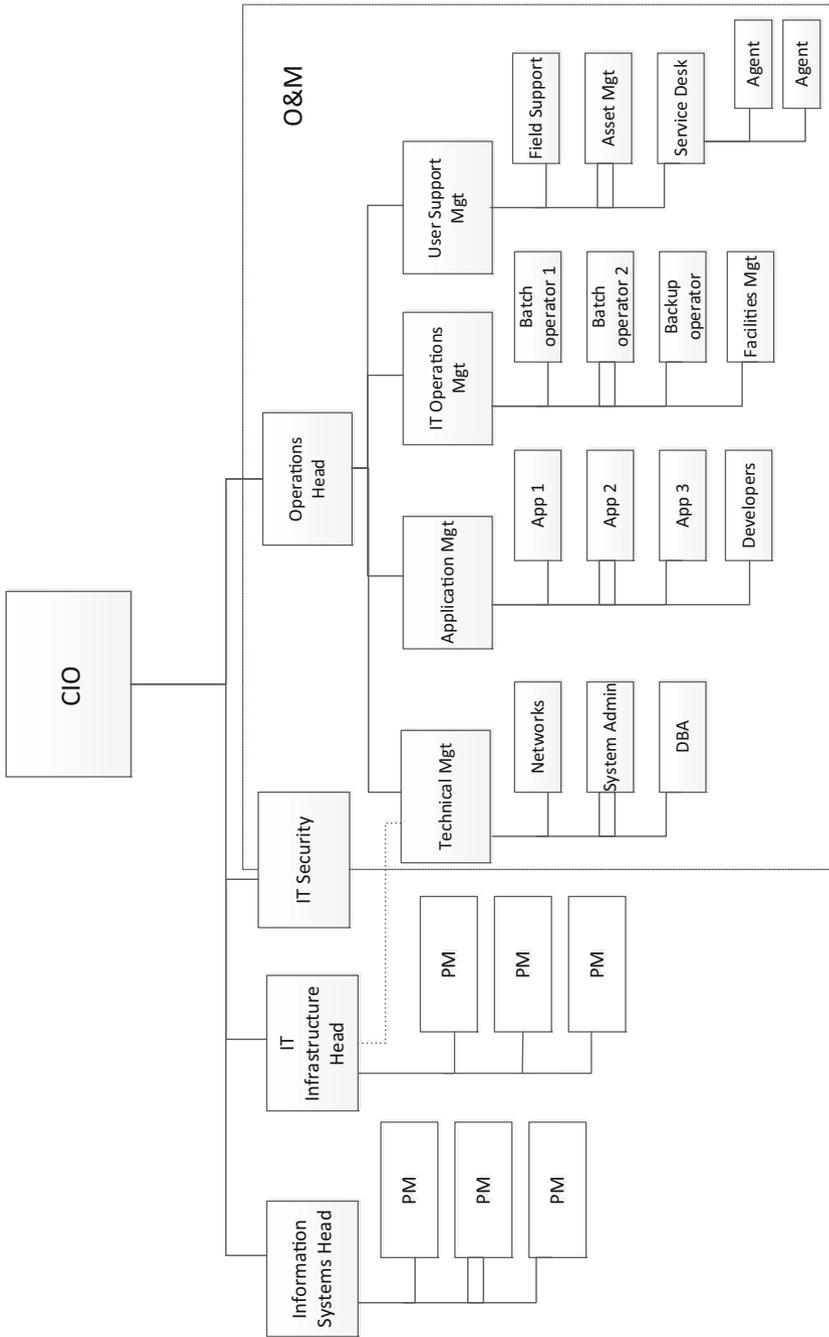


Fig. 3.5 Project and Operations combined IT structure

this case, he shall also be reporting to at least two bosses, and may not actually be evaluated by both, nor the boss from O&M appreciative of his work in the project. Due to these reasons, and unless the company is developing its own software platforms for outside sale, it is recommended to fully contract projects. This also has the advantage that the project can be contracted to a specialist in the project products without having to hire them full-time (as the project has a definite duration anyhow).

The IT Security Head on the other hand should have responsibility over both operations and projects. The reason for encompassing the latter as well is that if otherwise, vulnerabilities and security flaws allowed during the project phase are put into production, making remediation more difficult, time-consuming and costly. She as IT Security Head should impose security frameworks, policies, and guidelines to the project team even as early as the planning stage, as will be further explained in Chap. 10.

In the organization shown in Fig. 3.5, she appears reporting to the CIO, which is quite usual, but in some organizations, especially those that are prime targets of hackers such as banks, online commerce platforms, government organizations, and other financial institutions, the IT Security Head (then called CISO or Chief Information Security Officer) may be reporting to the COO or even the CEO. This has several advantages but also disadvantages:

#### Pros

- By reporting above the CIO, she has a direct line of communication with the business head.
- Awareness of security issues will be faster at the top level of management and, hopefully, will be given more importance.
- Insecure processes undertaken by the business may be addressed faster.

#### Cons

- Reporting the security issues at the top may create awareness, but not necessarily response to it. This is especially true if the top-level management is not tech-savvy and would not be able to relate to technical issues reported (and these may be deeply technical in some instances).
- There may be a lack of buy-in from the CIO in addressing the IT Security issues as he may feel it is not his immediate concern, making him delay or altogether ignore security recommendations.
- Recommendations by the IT Security Head may be impractical, may heavily impair IT operations, or may be very theoretical, lacking guidance on how to implement these.
- CIO is not directly accountable for IT Security.

Although at first it may seem that reporting to the CEO makes the IT Security Head more powerful, having her report to the CIO means that IT Security is now the

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CIO's ultimate responsibility as well, and he may have more interest in it, concern, as well as a more forceful hand in ensuring that IT Security policies, guidelines, recommendations, and fixes be undertaken with the appropriate attention and urgency by both the operations and the project teams, which in fact report to him.

Ultimately though, the best solution would depend on the nature of the organization and its practicality.



*Operations is the heart of IT as it is the first thing that needs to be addressed: keeping the existing infrastructure and systems running seamlessly to support the business. This chapter first centers on the discussion of Information Technology Service Management (ITSM) which defines the standards, roles, and responsibilities of the different IT Operation and Maintenance (O&M) personnel including the Service Desk, Technical Management team, Application Management team, IT Operations Management team, Field Support team, as well as the different heads in this organization which includes the Operations Head and the related Operations Management Office, the Information Systems (IS) Head, IT Infrastructure (II) Head.*

*After defining the different O&M personnel, we delve into the operations lifecycle: planning and design phase, release phase, maintenance phase, and retirement phase. Each of these phases has distinct aspects that need to be taken into account, and repeat in a cycle. Concepts for each phase are discussed including the different type of tickets: incidence, request and problem, how they should be defined, treated and escalated, and how these roll-up to the Service Level Agreement (SLA) that O&M commits to the rest of the organization.*

*Releases are most important to be done correctly, and this brings us to the topic of Configuration Items and CMDB and testing. Under the maintenance phase, requests and incidences need to be addressed, as well as long-term aspects such as availability and capacity management, security and business continuity. The retirement phase is briefly discussed.*

*O&M does not stop there, it also has a link to IT Strategy, and this is discussed in its own section, as well as how to incorporate Continual Service Improvement by means of the PDCA.*

## 4.1 Information Technology Service Management

IT service management (ITSM) is the process of aligning enterprise IT services with the business needs with the intention of delivering to the end user a service at its desired performance level. ITSM ensures that the right processes, people and technology are in place so that the organization can meet its business goals through the service provided by IT. One standard that has become a sort-of de facto in the IT industry is ITIL (Axelos 2011) which defines many of the nomenclature used in the IT industry today for managing IT Operations including much of the nomenclature used here, as well as the philosophy of how to handle operations. In this chapter, we adapt many of these principles but recommend concrete and practical ways of setting-up and managing your operations which most of the current standards do not define [some other relevant standards includes Microsoft Operating Framework (Microsoft Corporation 2008), ISO 20,000 (ISO 2011), and COBIT (ISACA 2015)].

We shall limit the use and definition of ITSM to cover that of operations only, and exclude Projects as these have their own distinct methodology. We shall also be using the Table of Organization shown in Fig. 3.5 from here onwards as our reference, and refer to operations as O&M to contrast it from ITOM (IT Operations Management).

It may seem obvious, that O&M should have precedence over all decisions made, especially with respect to managing releases (changes) into production, yet sometimes this is not practiced to the letter. Since O&M has a commitment in delivering a certain SLA to its end-customers, it has to ensure that no disruption to operations occurs. Projects, once cut-over into production almost always have some risk and disruption, so the timing, manner and preparation for the cut-over needs to be carefully worked on, and coordinated with O&M. Any release by any project will always need to be cleared with O&M before proceeding. For now, it suffices to say that under all circumstances, the Head of Operations needs to be consulted and should be in agreement with the cut-over of the project into production, more of this is discussed in detail in Chap. 6 under cut-over strategy.

Below we discuss the specific and detailed roles and responsibilities of each team shown in the Table of Organization.

### 4.1.1 Service Desk

Service Desk is the single point of contact for all users within an organization with IT for any request or incidence. This means that from their point of view, they need not understand the underlying Table of Organization, roles and responsibilities of each individual within the IT organization, but merely be aware of service desk, due to its customer-facing roles and responsibilities. When a user has an inquiry, request or incidence, he need to only refer to the service desk to obtain the necessary explanation, service or resolution. A user would also expect that this is done within a reasonable amount of time. A service desk is handled by operators which would open tickets in accordance with what is being reported.

Different channels may be used for contacting the Service Desk:

- Phone
- Email
- Web (self-service)
- App (self-service)

The service desk is also responsible for attempting First Call Resolution; this means its ability to resolve the inquiry or incident right on the instant when reported by the user. This means that the ticket can be closed much faster than if it is escalated, and also uses less technical and expensive resources (Service Desk agents) to handle the resolution vs. more expensive and specialized ones if escalated (AM, TM personnel).

Tickets opened by the Service Desk should follow the following classification:

- *Incidence*—any event which impairs the use of a service. It may also be an event that has not yet impaired service, but will do so if left unattended.
- *Request*—user’s request for information, advice, for change, or for access to an IT Service.

Tickets may be generated by both end-users, or internally by the IT staff. Best practice is that once the ticket is resolved, it goes back to Service Desk for confirmation of closure from the user thus, closing the loop in making the Service Desk the single point of contact.

The Service Desk is responsible for ensuring that tickets are opened with all the necessary information before escalation:

- *Complete description of the incidence or request.* This may include screenshots and detailed description of the issue, or a complete description of the request. It is the Service Desk’s responsibility to understand what information is needed before escalation, so as to avoid the ticket from delaying
- *Understanding who is requesting for the ticket.* This may be automatic (if through Web or email), but will not be if by phone, for example.
- *Classifying the ticket correctly.* Service Desk determines (either automatically by the SD system, or manually by the agent) the team the ticket should be escalated to, the approver, the information details required for the ticket, and this also sets in motion the count which will be used in calculating the SLA.

In order to maximize the amount of tickets resolved via First Call Resolution, an FAQ is usually facilitated to the Service Desk along with training and regular updates. Incidences are highest whenever a new project is released into production, so that Service desk agents must be trained thoroughly before the go-live of a project.

Once the ticket is escalated, it will follow its normal predetermined flow until the ticket is resolved or cancelled. Incidences should be resolved within the allowable time, however, it may be that the incidence’s root cause cannot be easily identified

either because it is totally new, is of a complex nature or may be due to many possible factors. In such a case a problem ticket is created by the assigned team (AM, TM, ITOM, US) and will remain open until the final root cause is identified. A problem ticket may also be referenced by several incidences, wherein all these incidences are related to a common problem (More of this explained under Sect. 4.5.3).

Even if the problem ticket remains open, it is important to resolve the incident as soon as possible, and that means that work-arounds may need to be applied, so that at least the service can still be delivered. Thus, once the work-around is effectuated, the incidence ticket is closed, but the problem ticket shall remain open. If upon further investigation the root cause of the problem ticket can still not be identified, several options exist (which may also be undertaken simultaneously):

- Consultation between different teams. As the root cause may reside in a grey area between the different responsibilities.
- Escalation to next level support. This may be to the software or hardware vendor's technical support team
- Recreation of the scenario in a sandbox environment for simulation and testing.

It is important to fill out details of resolution of incidences and problems in the company's Knowledge Base. These resolved problems and incidences with work-arounds are called Known Errors, and help in applying the resolution identified whenever the same incidence is encountered again. A properly designed Knowledge Base allows the different IT teams to search through it by content, ticket type, date, user, etc. quickly identifying past issues which are similar to the current, accessing the work-arounds and root cause and applying these to the current issue for final resolution. On the other hand, the process for the handling of problems is called Problem Management.

Not all requests and incidences are treated equally nor should they be given the same criticality, due to:

- *Impact on services (severity)*. Incidences which have a higher impact are more severe. As an example, a network incidence may affect only one user, a whole department, or the whole company, and therefore the priority given based on these should correspondingly increase.
- *User*. Not all users are created equal, and thus, requests and incidences reported by top management have a higher priority overall (VIPs), followed by managers, and rank and file, for example.
- *Type of incident or request*. The type of ticket being requested may also have an influence on the priority, this may be due to the known impact such a type of ticket may have over the business (affects customer service, for example), the expected response time for such type of tickets (request for password email reset for example should not take very long). It may also be related to the complexity of what is being asked, for example, a modification on the functionality of a program

Category	Sub Category 1	Sub Category 2 (Incident)	Incident /Request	Priority	Assignment
H/W	Printer	Can't print	Incident	Low	Service Desk
		Can't detect printer/printer not connected to network	Incident	Low	Service Desk
		Dirty Print Out	Incident	Low	Field Support
		Paper Jam	Incident	Low	Field Support
		Continuously printing	Incident	Low	Service Desk
		Printing inconsistent colors	Incident	Low	Field Support
		Printer not working/malfunctioning	Incident	Low	Service Desk
		Beeping sound	Incident	Low	Service Desk
	Servers	Blue screen	Incident	High	Technical Mgt1
		Infected with virus	Incident	High	Technical Mgt1
		Windows License Not Activated	Incident	Medium	Technical Mgt1
		Can't Boot/Corrupted OS	Incident	High	Technical Mgt1
		Beeping sound	Incident	High	Technical Mgt1
		Can't power on/ no power	Incident	High	Technical Mgt1
		Always restarts	Incident	High	Technical Mgt1
	UPS	Not working/malfunctioning	Incident	Medium	Field Support
				Low	Field Support
				High	Technical Mgt1
	Biometrics	Can't detect / not connected to network	Incident	Medium	Service Desk
	Switches	No power	Incident	Medium	Network Mgt
		Ports not working	Incident	Medium	Network Mgt
No connection		Incident	Medium	Network Mgt	

Fig. 4.1 Sample category matrix for a service desk

(which goes to AM), typically requires several man-hours analysis and therefore is not immediate, so it is of little avail to assign it a high priority.

The usual way for calculating the overall severity of the ticket (High-Normal-Low, or whatever other classification has been designed) is to come up with a matrix that calculates the overall criticality based on the priority assigned (from the above) as well as severity. See the example shown in Fig. 4.1.

The severity would be dependent on another similar table classification as shown in Fig. 4.2.

Thus, the overall severity will be based on a formula or table which defines the overall classification based on the above. For example, the formula may say that severity will be urgent for as long as the impact level is high or priority is high, minor severity incidences may be those with low priority, and so forth. It is important that once the ticket is routed, all users accessing the ticket have visibility over its classification, so that they can give due priority—even better if the service desk system automatically calculates the due date and displays this information as well.

**Fig. 4.2** Sample severity level calculation based on impact, priority and type of user

Priority:	VIP:	Impact:	Severity:
High	Yes	Enterprise	Critical
High	Yes	Whole zone	Critical
High	Yes	Whole office	Critical
High	Yes	Single user	Critical
High	No	Enterprise	Critical
High	No	Whole zone	Urgent
High	No	Whole office	Important
High	No	Single user	Important
Medium	Yes	Enterprise	Urgent
Medium	Yes	Whole zone	Urgent
Medium	Yes	Whole office	Urgent
Medium	Yes	Single user	Urgent
Medium	No	Enterprise	Urgent
Medium	No	Whole zone	Important
Medium	No	Whole office	Minor
Medium	No	Single user	Minor
Low	Yes	Enterprise	Important
Low	Yes	Whole zone	Important
Low	Yes	Whole office	Important
Low	Yes	Single user	Important
Low	No	Enterprise	Important
Low	No	Whole zone	Minor
Low	No	Whole office	Minor
Low	No	Single user	Minor

Proper training of service desk personnel is crucial for the process flow to execute correctly. It is service desk that will identify the impact the ticket has by means of her understanding of the issue, through interactive dialog, as well as whether the requestor is a VIP or not. Though the VIP tag may be automatically calculated depending on the ID of the user, take note that VIPs may not be the ones personally reporting to the Service Desk (i.e. their secretary or staff), so that needs to be captured correctly. It is also Service Desk that will classify the ticket correctly, so that the overall severity calculation takes place, and proper routing is done by the system.

Consider the situation in which a new proxy server was deployed by TM's networks group and propagated the change to the end-users' web browser, but failed to properly inform Service Desk. Upon going live, some users have issues with the change and are unable to connect to internet, so they report this to SD, however, because SD was not properly briefed, it merely escalates the issues to TM, which is now swamped with tickets. This could have been avoided by simply devoting sufficient time in briefing SD, which would then be able to resolve this under first call resolution.

Since SD is also the main contact with the users, they should be trained to analyze security concerns raised by them (suspicious emails, websites, attachments, etc.) and

be the first level of response and resolution if they are capable, as well as to know to whom to escalate to, if needed. Examples of this are blocking of malicious email domains; blocking of malicious websites, IP addresses, etc.; and escalating if further action is needed, especially from field support and networks. The reason for SD to handle these kinds of incidences is so as not to delay action (more is also explained further in Chap. 10).

### 4.1.2 Technical Management

The Technical Management team, as it names implies, is in charge of the IT infrastructure. Normally this includes:

- System Administration—In charge of Operating systems, applications.
- Database Administration
- Network Management
- Management of Servers and Storage

Some of the functions above, depending on the size and complexity of the organization, may be shared by different team members, such as the system administrator also performing functions related to the management of servers and storage, but take note that the skills required for each is quite distinct.

Two of the main preoccupations of TM are:

- Availability management and
- Capacity Management

Which are explained in more details in Sects. 4.5.6 and 4.5.7, however, to describe them simply, TM's first and foremost role is to keep things running, with minimal disruption to the service (availability management). On the other hand, capacity management refers to the allocation of resources to the different applications so as to ensure that there is no performance degradation to the service. Capacity management is especially relevant during the go-live phase of a project as it is the moment of truth in terms of how much resources are actually needed by the new system. During the lifecycle of a service, capacity requirements will also change due to the changing environment in which the service is used. Some of these aspects will be explained briefly in the next few sections.

#### 4.1.2.1 System Administration

Main functions of the SysAd are related to availability management and security. As new patches and versions are released for many of the different CIs periodically, the System Administrator needs to determine whether these need to be installed and when. Priority are security patches, installation of modules or versions which are to become outdated or support is to be ceased, as well as patches to address known issues. Next in the priority list are new versions which have functionalities required by AM due to a request or a planned change. Other patches and upgrades may be set aside until a more relevant event triggers their required deployment.

These activities are related to Availability management as failure to install and deploy these changes may result to incidences, or security breaches, as the case may be. It must be kept in mind that all new releases, and to a lesser extent patches, must be properly tested before release to production, and such testing, depending on the application, may be quite complex. If testing is complex, a comprehensive upgrade and test plan may be required.

In complex systems such as ERPs or core banking, modules within these applications are interdependent, so that a change in one module affects the other. It is for this reason that failures will most likely be in the FRICEW (see Sect. 5.3) when upgrading, as these customizations divert from the standard modules (and therefore interfaces between modules) released by the vendor (which of course, we hope were properly and exhaustively tested by the vendor before release, but actually may not be so). The proper planning for release management and upgrades is beyond the scope of this book, and is in fact quite dependent on the application, but take note that all customizations have a higher risk of failure when being upgraded as compared to standard functions.

Other very important functions of the system administrator are releasing changes into the different environments (QA, PROD), keeping track of these, and having readily available rollback procedures. One particular special release is user roles and authorizations. These are not normally authorized, nor determined by the SysAd, but are necessarily executed by him.

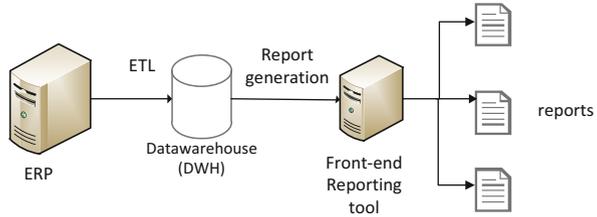
As an example of an incident related to improper testing, take the case of a patch being released by the ERP vendor to address known issues in its Java components. The patch update is then deployed by the SysAd immediately in the DEV, QA and PROD servers, only to find out that some customized Java displays in the portal that interfaces to the ERP are now not functioning.

Ideally, the O&M team needs to assess beforehand what is easier to undertake, either a straight deployment without thorough testing (maybe some very basic testing only of commonly-used affected transactions), or a staged DEV + checking, QA + thorough testing and then deployment to *PROD* once all the testing has passed. If the former is selected, a simple rollback procedure should be identified prior to the deployment of the patch. If the latter, then a complete test plan and test scripts should be developed as well. The final selection of release strategy will depend on the risks, impact and overall effort. Obviously if the risk and impact of a non-working deployment is small but the testing effort is big, then a straight-through deployment makes sense, while if either the roll-back procedure is complicated or the impact of wrong transactions is high, then thorough testing should be done before release to *PROD*.

#### **4.1.2.2 Database Administration**

Database performance, after proper allocation of server resources, is perhaps the second most common reason why a system performs poorly. Unlike most of the other resources which may need to be revisited as part of the capacity management process, DB administration is not as much related to capacity management as it is to regular tuning and maintenance activities. Database tuning and indexing are functions that should regularly be performed by the DBAs. Indexing also has to be taken into account by the programmers in the form of best practices for coding,

**Fig. 4.3** Sample datawarehouse architecture



otherwise no matter how much tuning and indexing is done by the DBA, performance will still be bad (again, a topic beyond the scope of this book). Wherever possible, the DBA may also flag to the developer (through AM) issues and improvements she sees that can be made on the code. A variety of tools exist for determining when and how DB tuning and re-indexing is to be performed, and are generally application and DB brand dependent. In general, the way these tools work is that they generate statistics as to the usage of different DB tables in terms of frequency, and their corresponding response time. Tables that are commonly accessed but are slow are prime candidates for indexing. Again, the DBA can only do so much as the manner of coding is equally important. Expensive statements which have many conditions on table entries while searching through many entries are very expensive, and may have to be written in a more efficient manner.

It is important to note that it is of tremendous help if the DBA understands the nature and behavior of the application that is accessing the DB. Different applications behave in different ways, and this helps in understanding the patterns of reads and writes that go into the DB, tables being accessed. For example, take a datawarehouse setup which extracts data from a transactional system as shown in Fig. 4.3.

In which the Extraction-Transformation-Loading (ETL) program extracts raw data from the ERP system and loads it into the Datawarehouse. Afterwards, the report generation kicks-in, transforming the data into a format the different reporting tools need, and stores these report formats into the DWH database. If for example the following schedules are observed:

- ETL: 1:00–6:00 am, weekly
- Report generation: 6:00–8:00 am
- Access to the reports by users: 8:00 am

Then this will help the DBA understand that massive writes into the datawarehouse will occur during the 1–6 am period that is run weekly, report generation which is a combination of read (mainly) and writes at 6–8 am, and massive read transactions at 8 am. He can also drill down to understand what tables are accessed by each process, and relate this to when slow performance occurs and in which part of the process.

The system administrator, now understanding the patterns may make suggestions on how to improve performance:

- Tune commonly accessed tables by each process
- Suggest on how to segregate different ETL batch processes. For example, if two batch processes are reading from the same set of tables, it would be faster to run them separately rather than concurrently so as to speed them up, as accessing the same tables simultaneously usually results in performance degradation. He may also opt to run some of the ETLs which have no interdependence in separate application servers while running them in parallel, in this way taking advantage of parallelism capabilities of your hardware infrastructure.
- Can suggest that certain reports be generated immediately after their ETL batch processes have finished, even while other ETL processes are still running but for which the reports' data are not dependent on, reducing the overall execution time for the whole process.

These are just examples, the specific architecture, ETL jobs, reports and the manner the tools work will determine the approach to take.

#### 4.1.2.3 Network Management

This involves both availability and capacity management. Nowadays with the advent of many tools used for monitoring network traffic, actual usage can easily be determined, this however requires quite a bit of analysis, as network traffic may not be all legitimate and not always readily identifiable. Proper network availability management is a combination of technical, analysis, and policy, all three being intertwined, there is no point in defining a policy that cannot be implemented because either the proper tools are not in place or there is no capability to analyze the traffic. Without proper policy and enforcement (also proper network design), the traffic will always grow to saturate the network, every upgrade being insufficient shortly after deploying.

For availability management, tools exist now which send SMS and emails to personnel whenever a link or switch goes down, facilitating response time. Most important in network management is the proper configuration of the switches, as well as the network topology and configuration. Nowadays with Network Management Tools, the job of identifying the CI details for each switch and router is made much easier, as well as the deployment of changes remotely. New patches and firmware versions are deployed according to priority (similar to what was discussed for the SysAd). One of the difficulties in network management is that the dependencies are network-wide, such that a change in one switch can actually affect the whole network. Another difficulty is that although lab deployment and testing is recommended for major changes, lab environments cannot capture the full condition of the actual environment once deployed, so that testing is limited at best.

An actual experience we had with a firewall was that although it worked perfectly well in a contained environment, once deployed it started degrading over time due to ever increasing memory utilization in the firewall appliance. This was in fact due to a memory leak (memory which would not release after

(continued)

it ceased to be utilized by a process), and after much investigation, was found to be due to blocked web pages' memory not being released properly. This was not detected in the contained environment as the number of such transactions was relatively small, but in the real-world example, was huge enough to make the problem apparent after a few days of having a lot of pages blocked. The bug fix was then released by the vendor's support and applied.

Sufficient capacity on the other hand should always be cross-checked to determine if the traffic is:

- Legitimate
- Due to a security breach/oversight
- Due to improper network configuration, especially loops or traffic taking very long routes
- Defined Quality of Service is proper (or necessary)

These should be addressed first before allocating additional bandwidth. Aside from capacity in terms of MBps, another important parameter that needs to be inspected is latency, which may also be due to:

- Improper configuration: switches, routers, appliance involved in the path need to have their configuration properly set, any one of them along the path causing the delay, delays the whole path.
- Nonoptimal network design: wherein for example the paths travelled through the network are very long, having to go through many switches before reaching the final destination.
- Overcapacity: switches may have been undersized (e.g. an edge switch used in distribution switch configuration), or appliances in the path having reached their limit.

Sometimes the latency may be thought to be purely network-related, but may reside in a grey area and not be so apparent. This may be especially true for intermittent slowdowns experienced by users. A good example of this is a problematic DNS server which takes very long to respond, affecting users intermittently. This issue normally cannot be seen by simply monitoring network traffic, and if no proper tools are available, will require lengthy analysis, also with the SysAd team until finally identified.

Also, illegitimate traffic may not be so easy to detect. Take for example a network in which policy allows the downloading and sharing of videos due to the nature of the business. Though firewall policy may be in place, this is still no guarantee that the videos being shared (which eat a lot of bandwidth) are in fact work-related, unless one physically inspects the videos themselves. This is where policy is important, as it is impossible to police all traffic 100%, but policy should state that any infraction to which a user is caught shall carry severe penalties.

#### 4.1.2.4 Management of Servers and Storage

These are most important during the go-live of a new service, since as indicated before, is the moment of truth in which the hardware requirements defined during the design phase are confirmed to be those actually needed. After going live, server and storage resources need to be monitored and tweaked, until the desired performance is attained. It is very important however that proper design be conducted from the very start before deployment, as is for example the proper design of the storage LUNs, or a very common mistake: assigning the wrong drives for the data and logs (C: is commonly used as the default, which is where the OS resides, and therefore not appropriate).

Unless environmental conditions change dramatically (e.g. number of users, patterns of usage) then availability should not degrade over time. Capacity management is however very important, and though it also does not commonly change very fast, it is susceptible to a number of factors:

- Change in the number of end-users
- Growth of data over time (disk storage)
- Additional application modules being deployed
- Change in the schedule of batch processes. New schedule may coincide with some other operations that consume a lot of CPU and memory.

Part of IT Service Continuity management, as well roll-back procedures is regular backup. The definition of the backup procedures will still reside with TM, including restoration procedures.

#### 4.1.2.5 Technical Management

The head of the Technical Management team has a very important role which includes:

- Making sure skills are up-to-date and relevant. If necessary, conducting hand-holding, internal and external sessions and ensuring these are scheduled and conducted.
- HR resource capacity management. Should be sufficient for the work on hand, and should have sufficient resiliency and redundancy in case of resignations or prolonged sickness
- Overall understanding of the technical architecture, including management of its corresponding documentation
- ITSM documentation custodian and overall Quality Assurance supervisor
- Compiling all major CIs requests that translate into additional procurement requests
- Assignment of tickets to personnel within the team, in case these have not been routed directly
- Monitoring of team's compliance to the SLAs

Aside from this, he has to interface exhaustively with the Head of IT infrastructure, in assisting projects that will be phased into production. Unlike software projects, infrastructure projects cannot usually be separated from existing operations as they need to take into account the overall existing architecture and design. Testing

for infrastructure projects before deployment will also be a major time-consuming role for TM.

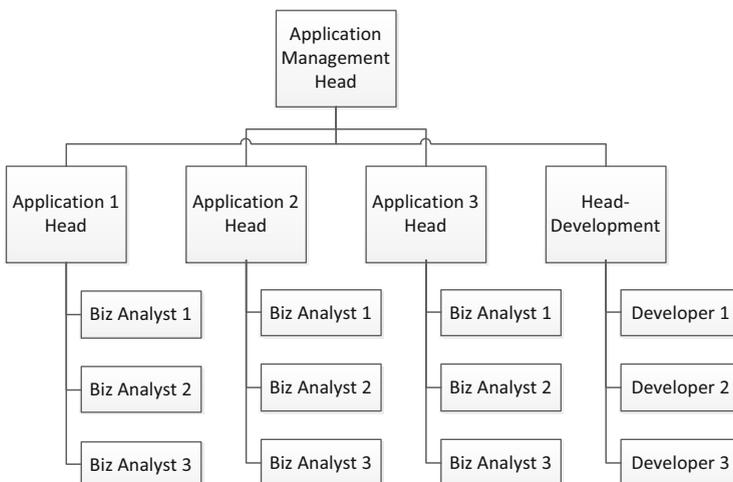
As an example, imagine a project which needs 10 new servers to be provisioned. Though the existing capacity may be able to meet this new requirement, TM needs time to understand the requested architecture and scrutinize the requirements before proceeding to provision these. The project may also be competing with other projects for the infrastructure or even the time devoted by the TM team.

### 4.1.3 Application Management

The Application Management (AM) team is in charge of all CIs related to software. They also have a very important role, which is to act as the bridge translating business requirements into technical specifications. They must be knowledgeable of the functional aspects of the different applications, including possibilities and limitations, so that when translating these functional specifications, they are aware on what can be done, and how it can be done, with minimal customizations if possible.

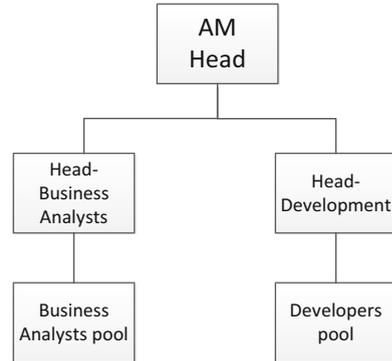
An AM team can be structured according to application type as shown in Fig. 4.4.

So that specialists occur for each particular application 1, 2, 3 and also a general pool of programmers exists that can work on specific tickets (vs. applications), depending on the programming technology required. If the changes for the different applications are few, then a full-time head per application may not be required, and resources may be shared thanks to cross-skilling, so that Business Analyst 1 for example, may be the same person for both Application 2 and 3, as the number of



**Fig. 4.4** Structure for Application Management team

**Fig. 4.5** Alternate structure for Application Management team



tickets for these two applications is low, and he has the skills to maintain both, resulting in the structure shown in Fig. 4.5.

Availability management is not very relevant to the AM team, and capacity management only in terms of resources. On the other hand, ticket handling by the AM team is of crucial importance as incidences and requests sent to this team are usually more complex in nature and require more analysis. Let us analyze incidences and requests separately.

#### 4.1.3.1 Application Management: Incidence Handling

Most application-related incidences occur after the go-live of a project due to the novelty of the application and system, in which the only incidences already identified are those discovered during the testing phases, which seldom are really very complete in nature (as explained under the testing section). Long after going live, additional incidences may occur due to:

- Not commonly-used transactions or data-transaction combinations being used for the first time
- Upgrades in some of the technical CI components
- Modifications undertaken in some of the applications' modules which affect others

As an example of a modification which affects other modules, take a utility billing system where new potential customers are created upon their application for a service. Provisioning of the utility service however requires an initial payment from the customer *AFTER* it is ensured that the customer's location can be provisioned with the service. Inadvertently, if this initial payment is created as a receivable in the finance module and it takes a considerable time to validate the application and receive the payment, this may cause a bloating of receivables which may not necessarily reflect the true state of the business.

(continued)

Eventually either these are paid after a considerable amount of time, or may need to be reversed due to non-availability of the utility service, or failure for the potential customer to pay. This means that they were not actual receivables due to the normal conduct of the business, but actually more of an anticipation of payment from the potential customer.

Incidences may be of differing nature:

- Program gives an error and cannot proceed
- Program does not perform intended functionality, giving a different output from what is expected

The second type of incidence is usually harder to analyze and resolve.

Take a timekeeping system which feeds into payroll. Imagine that its configuration is such that employees working overtime are to be paid a special rate, and that the timekeeping system is built such that all extension beyond the 8 am to 5 pm period calculates as overtime pay. It is however overlooked that there is a night shift which actually starts work at 5 pm, which is not entitled to this overtime pay, but an altogether different pay rate. This is an example of a program failing to give the desired functionality, but not a hard error.

AM-related incidences are usually harder to resolve as they may occur only based on certain conditions (data), and this data may not be always used by the transaction that is failing. It may be necessary to reproduce (simulate) the error for the purpose of testing and analysis, and sometimes this may not be so easy. In case the incidence cannot be resolved immediately, workarounds must be given until the final resolution is determined. A problem ticket may also need to be raised if the root cause is not determined within a reasonable amount of time, and assistance may be sought from second level support.

As for requests, these also require sufficient effort to analyze, oftentimes because the request is incomplete in terms of specifications, and then requires an interaction between the business analyst and the end-user to determine exact requirements. For this purpose, documentation on the request is to be filled-out, together with details filled-up by the analyst in terms of implication, whether this is a configuration, what needs to be done in order to address this request, if it requires some customization, at what level: code, fields, tables, objects and the corresponding man-day effort. Oftentimes the code may be a modification over an existing standard code, so that the standard code is referenced. More information on the suggested documentation is specified in Sect. 4.4.3.2.

Any modifications related to the application will raise a change request and trigger the change management process, which normally should also be handled by the service desk system. Change management triggers an approval process (normally with the CAB) which is dependent on the company's IT policy. This is discussed in detail in its corresponding section.

### 4.1.3.2 Application Management: Development

It is best practice that developers be shielded from the end-users and should only receive instructions on what is to be coded from the corresponding Business Analysts. As the developers are usually a pool (unless many of the applications are custom-coded and require an almost full-time dedication), their assignment to different applications will be on a case to case basis based on the tickets generated, programming skills required, and the load of each developer. Best practices in terms of coding standards and security should be imparted by the developers' head and disseminated and improved by the team.

### 4.1.3.3 Application Management: Overall

Among the roles of the AM Head are:

- Making sure skills are up-to-date and relevant. If necessary, hand-holding, interpersonal and external sessions are to be scheduled and conducted
- Personnel capacity management. Should be sufficient for the work on hand and should have sufficient resiliency and redundancy in case of resignations or prolonged sickness
- ITSM documentation custodian and Overall Quality assurance supervisor
- Assignment of tickets to personnel within the team, in case these have not been routed directly
- Monitoring of team's compliance to the SLAs
- Maintaining coding standards
- Maintaining configuration standards and guidelines
- Improving on the documentation needed in determining scope
- Assignment of tasks to developers (if there is no development head)

### 4.1.4 IT Operations Management (ITOM)

IT Operations Management is the "heart" of IT, as it manages all aspects that directly concern the end-users: the day-to-day activities that ensure to the users the availability of the different IT services. Of all the teams, it is perhaps the least technical, and yet is, the most critical in terms of perceived impact by the users.

It has two main functions:

- IT Operations Control, which can be further subdivided into:
  - Console Management
  - Job scheduling
  - Backup and restore
  - Print and output
  - Report generation
  - Data investigation and resolution

- Facilities Management
  - Data centers
  - Recovery sites
  - Contracts (for the facilities)
  - Consolidation
  - Common facilities management

In other words, the first set of functions under IT Operations Control are functions related to batch processes that are scheduled and run as part of normal IT Operations. ITOM checks for the successful completion of these as part of its functions, and analyzes errors, reports them for resolution (usually to AM or TM if they cannot get to the root cause) and rerun these batch processes as required. An important function as well is to investigate issues which are data-related that impede some ITOM job from proceeding. Incorrect data is usually attributed to causes at the source (end-user or external third party) and are typically due to:

- Incorrect transactions being undertaken
- Wrong procedure by the end-user
- Incorrect data being provided by a third party (such as a bank, outsourced provider, etc.)
- Errors in some of the source files being utilized

ITOM will investigate the source of the data error and either fix it directly, or coordinate with the concerned party for them to correct.

On the other hand is the facilities management function. In many organizations this function has not been fully turned-over to the ITOM group and may still reside with TM due to the skill set, as well as for historical reasons. End-user common facilities that should also be handled by ITOM are those common to many end-users:

- Timekeeping systems
- Deployed general-use PCs (vs. those assigned to specific users)
- Displays and PCs in common-use areas of the company
- Others

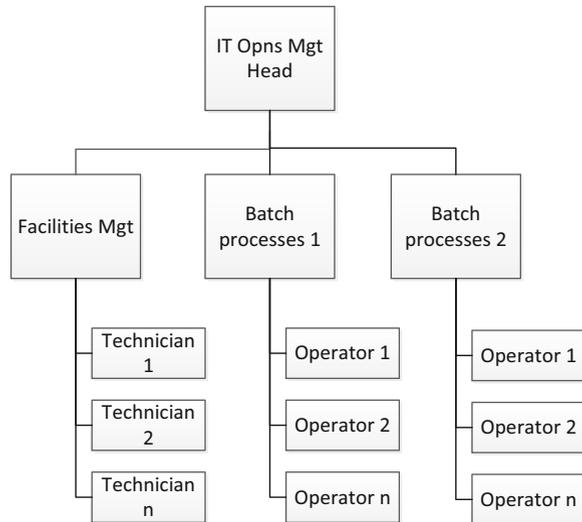
ITOM should ensure their availability in terms of the hardware, as well as their content.

The table of Organization for ITOM is typically that shown in Fig. 4.6.

In this diagram and depending on the number of batch processes, operators may be separated into different teams, with or without a head per team. If the number of batch processes is few, then all operators are placed in a common pool, and each operator may undertake different functions.

The facilities' technicians will also work according to specialization, as for example, those assigned to the data centers will monitor data center parameters like air conditioning, electricity consumption, etc.

**Fig. 4.6** Structure for IT Operations Management team



### 4.1.5 Field Support

This refers to the team that conducts the troubleshooting, configuration and repair of endpoints (user's assets such as PCs, smartphones, laptops, printers, and other peripheral devices). Common functions of the field support team are:

- Configuration of endpoint devices. This may be done:
  - On-site: meaning, the technician will be physically present where the user is
  - Remotely: by means of remote support tools, such as:
    - Remote desktop
    - Remote patch deployment software
    - Remote antivirus deployment engines
    - Etc.
- Repair of endpoint devices. This may be first level support & repair for out-of-warranty devices, especially for small repairs like replacement of common components (capacitors, resistors), replacement of power supply, cords, etc. This may include pulling out of the units and bringing to the repair shop.
- Installation of baseline configuration (the standard software and configurations) for new endpoint devices before releasing to the users
- Assistance to end-users on field if service desk is unable to service the request or address the incidence remotely
- Coordination with suppliers of end-point devices for their repair or replacement
- Receipt of IT equipment deliveries from vendors, storage and subsequent release to the end-users
- Proper disposal or resale of end-of-life IT equipment

- Regular Endpoints' Preventive Maintenance. This may include cleaning of PCs, laptops, printers, as well as running of diagnostic tools and defragmentation of endpoint devices.
- Installation of endpoint equipment (for those that cannot be simply done by the users), as well installation of additional hardware to endpoints (such as memory cards, graphic cards, etc.)
- Regular patching of endpoints.
- Managing the email system which includes setting up and updating its settings regularly (especially with regard to security aspects) and refining configuration settings for security issues reported by the users (such as phishing, spam, spoofing, etc.); this, together with other functions, is further explained in Chap. 10.

In the table of organization proposed, both the service desk and field support report to the User Support group, which in general is in charge of all interactions with the end-users.

#### 4.1.6 Operations Head

The operations head is the overall person responsible for O&M as depicted in the Table of Organization shown in Fig. 3.5. The duties and responsibilities of the Operations Head are:

- Overseeing the Service-Level Agreement (SLA) that measures the effectiveness of the O&M team towards the end-users.
- Overseeing and managing the Operational Level Agreement (OLA) that measures the internal agreement between the IT Management and the O&M team. This OLA is typically more stringent than the SLA to allow for some buffers and slippage.
- Ensuring compliance to Operations' governance policies, as well as tuning and improving these policies and implementing guidelines in order to make operations more effective and responsive to end-user needs.
- Overseeing competencies and skills of the O&M team, ensuring they are attuned to the needs of operations, identifying skill gaps and conducting actions that decrease these gaps. These may include internal trainings, handholding, external trainings, immersion programs, etc.
- Planning for and managing trainings, in accordance with the skill gaps identified previously.
- On-boarding for new team members. Consists basically of the preparation of material for quick on-boarding, as well as a training and hand-holding plan for them to quickly ramp-up and be productive in the shortest possible time.
- Regular performance review of team members, and identifying corrective actions for those with deficiencies.

- Skilling-up, researching for new techniques to further improve operations, and implementing these.
- Driving continuous improvement to the team via PDCA (see Sect. 4.8 for more details).
- Fostering an environment of learning and growth, as well as good team relationships.
- Coordinating with the IS and II Heads on projects that are being transitioned into Operations, and identifying the correct O&M resources that need to be involved in the cut-over.
- Providing the necessary resources to IS and II for support to projects which necessitate O&M involvement (especially interfaces, data migration).
- Overall caretaker of the Business Processes that all the different applications are using. In this aspect, the Operations Head should ideally be very familiar with the existing Business Processes so that she can critique any new change to the existing BP and see if applicable.

Of all the three heads, Operations Head, IS Head and II Head, the Operations head has the most power as she has the authority to veto any project or initiative from IS and II which may go into production, or affect operations. This is because ultimately, she is responsible for the SLA to the end-users and must ensure that these are met.

As indicated, the operations head is also in charge of governance and ensuring that O&M complies with it, this means:

- Ensuring ITSM policies are strictly enforced
- Ensuring security policies are complied by both the IT team, as well as the end-users.
- Reporting and communicating any breaches to the CIO

Communication to the CIO on the above is done on an as-need basis, however, day-to-day monitoring and management of operations usually involves:

- Regular operations meetings with the O&M team and CIO (usually weekly), in which the tickets for the last time period are reviewed and analyzed. This analysis includes:
  - Number of tickets created: incidences, requests and problems
  - Number of tickets resolved. Operations needs to ensure that there is no increasing backlog of tickets, which will result in an ever increasing backlog as time goes on.
  - Analysis of tickets per team. These are monitored for unusually heavy activity and analyzed for the underlying reason.
  - Repetitive incidence tickets which usually point to an underlying problem causing multiple generation of incidences.
  - Status of incidence tickets after a major project has been implemented. Usually incidences will spike after go-live but should continuously decrease afterwards.
  - First call resolution. FCR should be maximized so as to avoid escalation which results in delayed ticket closure.

- Team leads' Operational reports, which normally is done as part of the Operations meeting, in which each team reports activities conducted for the period, issues, and resolutions. Team may also ask for guidance on matters they are unsure on how to proceed.
- PDCA or continuous improvement

#### **4.1.7 Operations Management Office**

This is the office wherein the head for Operations is, which oversees all operations under her. This office is composed of:

- Operations Head: in charge of the whole O&M to which the AM, TM, ITOM, US heads report to
- Support staff

The support staff functions include:

- Producing all SLA and regular operations reports
- Design, drafts and implements the different operational policies
- Internal audit (for the O&M group) to ensure compliance
- Regular review of policies
- On-boarding to new members coming into the team
- Debriefing and clearance for departing team members

On the other hand, the Operations head is the primary responsible party for managing and ensuring that the O&M team complies with the prescribed SLA. Her primary duty includes:

- Regular reporting to the portfolio manager. She ensures also accuracy of the reports; this also entails discussion and finalization of the SLA KPIs attained by the team.
- Internal Billing and availability reporting
- Ensuring that the skills needed by O&M are met. This includes resource matching, sourcing and releasing of human resources.
- Updating the O&M team on policies.

#### **4.1.8 Information Systems (IS) Head**

As described in Sect. 2.1, a best practice is to separate day to day operations from strategy and especially, projects, reason being that the methodologies for managing IT operations and projects differ considerably. Also, software projects can in fact be totally isolated (usually) from operations, a different environment, in a different

team, and even in content and scope, so it makes more sense to have a separate team in charge of these altogether.

The Information Systems Head is in charge of all software-related projects, and therefore is its portfolio manager. He is in charge of managing these from conceptualization through development and execution until these projects go-live and is transitioned to O&M during the support phase.

His main duty for all software projects includes:

- *Planning and strategizing*: determine what new projects are needed in order to meet the company's plans, objectives and strategies. This is a normal function of a portfolio manager, and is a continuous process as is explained in Chap. 9.
- *Overseeing the portfolio of projects*. This includes all those responsibilities described under portfolio management for its whole lifecycle of the portfolio—Most importantly, the monitoring and control of the projects, regular communication with the stakeholders, as well as ensuring that portfolio governance is followed.
- *Coordination and proper turn-over to O&M*. This is done from an IT technical and functional aspect as discussed in Chap. 6, but also from a business aspect meaning he has to maximize the success of the project once it goes into operations in delivering the business benefit(s) it was designed for.

With regards to human resources, the IS Head may dispose of full-time project managers under, him or just manage PMs as their respective projects are assigned under his portfolio (part-time resources for the duration of the project). As for resources under his respective PMs, these may be fully contracted out as turn-key projects, may be using in-house resources which have been mobilized and assigned for the duration of the project, or a combination of in-house and outsourced. Only in the first case are resources wholly managed by the contractor's PM, for all other cases (and sometimes even for the first), the project resources will have to be fully managed by the customer PM.

Governance is an aspect of utmost important to the IS Head, as it determines all aspects in which his portfolio is to be managed (more in Chaps. 7 and 9):

- How projects are to be monitored. These are the tools given to each PM in monitoring and controlling the projects, which in turn are reported to the portfolio manager (IS Head).
- How results are communicated to stakeholders. In which the manner, periodicity and channels used are defined.
- Conditions and steps in starting a project. A project may be requested from an end-user organization or internally initiated, the procedure and conditions for initiating a project need to be properly defined.
- Minimum documentation and deliverable requirements. These should be in the form of templates which the PMs can easily adapt to their respective projects.
- How changes in scope (and change requests) are to be raised, analyzed and approved.

- How to transition a project into operations
- Project closure

Software projects affect both operations and hardware projects, so that there needs to be close coordination between all three. Specifically for operations the turn-over activities specified in Chap. 6 need to be followed by all PMs. Specifically:

- During the start-up phase of the project, O&M needs to be informed of the project and given a high-level overview of the project
- All infrastructure requirements need to be discussed with TM and/or II Head for the provisioning and capacity planning during the beginning of the project. This also includes operational aspects such as backup and restoration procedures, security, among others.
- Training and handover right before going live (TM, ITOM, AM)
- In-depth discussion of technical and process information also before going live to the O&M team
- Briefing to SD before going live
- Post go-live Support scheme to be used involving the project team, O&M, as well as first and second level product support from the principal.

The infrastructure requirements of the different projects under the IS Head need to be discussed even before the project has started, so that planning, provisioning, and in some cases purchasing of additional capacity or special hardware can be done in time for the project. This discussion needs to take place with the IT infrastructure Head (next section), as he will ensure the overall technical architecture to meet the projects' requirements, while at the same time ensuring operations, as well as TM, which will be the team to do the actual provisioning.

#### **4.1.9 IT Infrastructure (II) Head**

The IT infrastructure (II) Head is the direct counterpart of the IS Head. In the same manner that the IS Head is in charge of all software projects, the II head is in charge of all infrastructure projects. This includes, but is not limited to:

- Servers
- Storage
- Network devices
- Security appliances and software
- Databases
- Virtualization
- Cloud technology
- Operating systems
- As well as all components that may fall into the above

Besides projects, the II Head has to ensure coherence of the overall architectures for the different applications, whether these are in operations, in projects, PROD, QA or DEV. For this reason, his responsibility spans across both operations and projects.

Among his duties are:

- *Planning and strategizing*: defining what new projects are needed in order to meet the company's plans, objectives and strategies. This is a continuous process, and he is responsible for the portfolio of all infrastructure projects.
- *Overseeing the portfolio of projects*. This includes all those responsibilities described under portfolio management for its whole lifecycle—Most importantly, the monitoring and control of the projects, regular communication with the stakeholders, as well as ensuring that portfolio governance is followed.
- *Capacity planning*. Reviewing current capacity, usage projections, and triggering procurement for additional capacity as may be needed. This applies to servers, storage, network, as well as software components.
- *Availability management*. Reviewing availability of infrastructure components with TM and O&M in general, and proposing new strategies in order to meet the required availability requirements
- *Security*. Reviewing and proposing new security policies, guidelines, as well as appliances and software that may be needed in order to meet the security requirements of the organization, in coordination with the IT Security Head. In smaller organizations in which a full-time IT Security Head doesn't exist, the II Head will take up this role mostly in direct coordination with the CIO.
- *Resource skills management*. Ensuring that the skills and competencies of the team (both O&M and projects team) are commensurate with requirements, will flag and plan for required trainings, additional personnel whether long-term or contractual, as well as personnel which may be taken out of the team (if outsourced).

As all IS projects require infrastructure, regular meetings should be held with the IS Head to plan for the necessary capacity:

- *Annual capacity review*. This may be done more often, depending on the speed in which requirements come, and is conducted together with the IS and Operations Head, ensuring that for the next time horizon hardware capacity will be sufficient or if otherwise, will initiate a procurement process.
- *Provisioning based on IS Project requirements*. Any new project will require additional hardware resources, and so these will be requested formally through an infrastructure request form which will trigger review and provisioning. It is recommended however, that a meeting at the start of the project be conducted to review the proposed architecture, hardware requirements, so as to ensure that these are acceptable and a good understanding on both sides occurs. It is very common for project teams to overdesign the specifications, so this meeting is conducted in order to rationalize these.

Similar to the IS Head, the II Head is in charge of all hardware-related projects, and is therefore its portfolio manager. Once more, he is in charge of managing these projects from conceptualization through development and execution until these projects go-live and is transitioned to operations during the support phase.

His main duty for all infrastructure projects includes:

- *Planning and strategizing*: defining what new projects are needed in order to meet the company's plans, objectives and strategies. This is a normal function of a portfolio manager, and is a continuous process.
- *Overseeing the portfolio of projects*. This includes all those responsibilities described under portfolio management for its whole lifecycle of the portfolio—Most importantly, the monitoring and control of the projects, regular communication with the stakeholders, as well as ensuring that portfolio governance is followed.
- *Coordination and proper turn-over to O&M*. This is to guarantee that from the moment of go-live, the infrastructure can be taken over and maintained by TM. Proper training as well as hand-holding is necessary for this to become a reality.

Similar to the IS Head's setup, resources may be full-time or part-time depending on the philosophy and Table of organization. Another similar, important aspect is that of governance, which for infrastructure projects, again resides with the II Head. Governance rules and project templates should generally be the same as that for IS so that they are in concordance, but may have its own, small particularities. Generally, the II templates are much simpler than that of IS'. Refer to the governance roles described under the IS Head, as these are directly applicable as well for the II Head.

Important aspects on II projects (or infrastructure components in IS projects) that need to be coordinated with O&M (TM specifically) are:

- During the start-up phase of the project, O&M needs to be informed of the project and given a high-level overview of the project
- Overall architecture of the new project being initiated. This must be approved by both the II Head and TM.
- Also during project start, discuss with TM all infrastructure requirements for provisioning.
- Backup and restoration procedures for the specific application being implemented.
- Release management procedures. These are going to be executed by TM, so it is imperative that TM understand and approve these.
- Training and hand-over right before going live (TM, ITOM, AM)

### 4.1.10 IT Security Head

As mentioned briefly in Chap. 3, the IT Security Head (ITSec Head) has a role not only in Operations, but also in projects and his responsibility should span across the entire IT organization, and if an industrial control part is also present in the company, then that as well (commonly called OT, short for Operational Technology). Hackers do not make any distinction between IT and OT, and so it necessitates a single person responsible over everything. On the other hand, the ITSec Head's oversight over projects will ensure that all applications and infrastructure being developed there follows secure practices, and not becomes a problem once these are already in production, or shortly before being put into production.

The ITSec Head participates at every stage of a project, starting from the planning, and most importantly during the architecting and design. Some important aspects here include:

- All IT infrastructure architectures must be inherently secure, and for that reason, he is to review these.
- All software components inherently carry vulnerabilities which are discovered over time; he reviews and ensures that these applications and components are indeed not vulnerable, based on the security industry's current recommendations.
- If the project is to be built from scratch using coding, then a Secure Software Development Lifecycle (SSDLC) framework must be followed, with the different checks at different important stages of the software's development.
- Also for software in general but especially for custom code and all applications facing the internet, OWASP guidelines must be taken into account.

In order to test the software for vulnerabilities, white box, gray box, and black box security testing may be used, which are discussed further in Chap. 10.

In O&M on the other hand, IT Security is equally important, as hackers continuously attempt at penetrating into companies to steal trade secrets, make a profit, steal customer information, and the like. Thus, it has become normal to get several penetration attempts in a day. If properly architected, patched, and protected, then these attempts will just be that, attempts. However, there will be intrusions at some point and, once detected, must be quickly neutralized and analyzed as to how they got in, and those "holes" quickly closed so the situation will not recur. As such, the ITSec Head and his team will normally be handling both:

- *Incidences*—as is explained further in Chap. 10, an incidence may be classified as an event, a security incidence, or a breach, in order of ascending gravity. In any case, these will be handled using the SD and an incidence ticket created. It will then follow escalation procedure as per the company's cybersecurity incidence response plan until the incidence is resolved.
- *Requests*—in which the ITSec Head must review for (dis)approval a CI change which has security implications. A Sample of these requests is opening of a

firewall port, temporary disabling of a security measure, or requesting for a privileged account.

We shall be talking about security requests further in Sect. 4.3.1.2, but for now, it is important just to understand the ITSec Head's role.

One very important role the ITSec Head has is in formulating security policies and guidelines, to which projects, operations, and even end-users must adhere to. As will be discussed in Chap. 10, it is important that all software implementations and configurations adhere to these policies, which will serve as the guide as to what needs to be done to secure the company's IT Assets and the manner in which that is to be done. They are the basis of how all configurations are to be undertaken and form an important part of overall IT governance. Several forms may exist:

- *Overall IT Security policies* refers to high-level recommendations or requirements which are further refined in the actual implementation guidelines. It is advantageous to separate the high-level from the working-level instructions as security recommendations change quite often. An example here would be to require all applications to use salted and hashed passwords, together with an additional acceptable multi-factor authentication (MFA) mechanism, without going into further details.
- *Implementation guidelines*—more detailed, which can be changed as security recommendations evolve with time. Continuing from the example above, the guidelines might indicate to use a 15-character password length and must use at least 1 letter, number, and special character in them. These guidelines are written mainly for IT in their execution of projects as well as operations.
- *User security guidelines*—guidelines built for users as a guidance on safe and unsafe practices. Unsafe practices may be indicated as company violations with their corresponding gravity/penalties. Examples of this are unauthorized installation of software, running bitTorrent in company computers and network.
- *Data privacy guidelines*—if the company has a full-time data privacy officer (DPO), then the ITSec will develop this one in coordination with the DPO. These guidelines will indicate how Personally Identifiable Information (PII) can be safeguarded by means of both technical and procedural safeguards.

The ITSec Head's last important role pertains to that of leading audit and security testing endeavors; this is to close the PDCA (plan-do-check-act) loop: in this case, (1) to check that the measures prescribed are indeed being followed and have been implemented and (2) to test the company's defenses against external attack. Based on these results, the "act" part of the PDCA cycle is then undertaken, which is to tweak and improve the existing setup.

With regards to audit, these should generally be a combination of regular internal audits, followed by external audits. Internal Audits should be undertaken by the ITSec Head's staff, or if these are too few or non-existent, then he can pull in resources from other teams. It is important to note though that these pulled-in

resources be properly trained beforehand and must not be the same people executing the configurations in the first place. Aspects that can be audited include:

- Usage of privileged accounts and whether these are in accordance with the policies and have gone through proper approval.
- Configuration Items (CI) of critical assets.
- Backups, their regularity, and adequacy.
- Business Continuity results.
- Policies implemented in firewalls, WAFs, IPS, etc. All internet-facing appliances are considered critical assets.
- Patching updates.
- Logs of critical assets.
- Etc.

As for testing, they may take many forms such as:

- *Tabletop exercises*—In which a hacking attack is discussed and the different relevant participants discuss in turn how they would address such a scenario.
- *Simulated attacks*—An actual hacking attack is simulated, and the whole incidence response is triggered until final remediation. The audit team witnesses the whole process and takes note of further improvements and recommendations.
- *Vulnerability scanning*—Using automated tools to regularly scan IT Assets for possible vulnerabilities.
- *Penetration testing*—In which an ethical hacker is hired to try and penetrate the organization's network and access critical IT Assets, using a combination of automated tools and manual techniques.
- *Others*—This field is continuously evolving, and many other techniques exist or are being developed.

It is important to note that the ITSec Head must always work closely with the IS Head, Opns Head, and most importantly the II Head and the CIO. Without their buy-in, all good intentions will just remain as non-implementable policies.

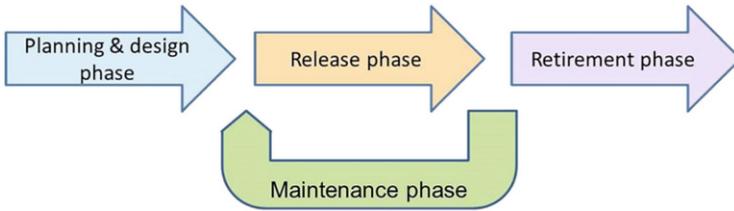
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## 4.2 IT Services Lifecycle

In general, IT services are planned, designed, created, released and then maintained and operated and then retired, so these can be broken down into four distinct phases:

- Planning and Design phase
- Release phase
- Maintain phase
- Retirement phase

These can be represented conceptually by the diagram shown in Fig. 4.7



**Fig. 4.7** The IT services lifecycle

**Table 4.1** IT vs. end-user point of view in the delivery of services

Example of technical services (IT’s viewpoint)	Example of IT services (users’ viewpoint)
Network availability	Email
Servers’ availability	Financial Management Sys
Storage response time	Billing services
Report application’s availability	Reports
Firewall availability	Internet

Initially a service is planned for and designed accordingly; this may come from a user’s request, may be internally escalated, or may be a transition from a project. Release phase refers to that of placing these new IT services or changes into operations as part of the applications in production, which render the service to the end-users. During the course of delivering this IT service, the service needs to be supported and from time to time enhanced, which may entail additional releases. Lastly, if there is no need for the IT service, it is uncatalogued and decommissioned under the retirement phase.

IT services are therefore created, deployed, maintained and improved and eventually, retired.

What is exactly an IT service? The key to the answer is in thinking not from the point of view of IT (technical perspective), but from that of the users’, which is IT’s customer. The service must be something of value to the users. Thus, for example, the servers and storage being maintained by IT may be thought of as a service by IT, but indeed, it is not from a customer’s perspective. This is because the customer does not care about the availability of the storage, servers and their components, her concern will be on the availability of the financial management system application (for example) which runs on servers, storage and the network, and which she needs in order to conduct her work properly. Thus, from the customer’s perspective, it is the availability and adequacy of the financial management system as a whole that is a service to her. To understand this further, take a look at Table 4.1 which shows some examples (note that the left hand column does not have a one to one correspondence with the right hand column):

So in fact, for every service indicated on the right hand side of the table, their availability and usage actually depend on many different technical services in order to be able to render the desired and expected performance. Thus for the example

earlier, the financial management system, if the concern is availability and response time of the application, it in turn depends on the availability of the network, servers, storage, application, as well as their corresponding aggregate response time.

The compendium of all services which are delivered to the end-customers is thus called the service catalog, and it is this list of services in the catalog which are maintained throughout the whole service cycle (planning/design-release-operate/maintain-retire).

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### 4.3 Planning and Design Phase

Services are created for the purpose of servicing a demand by the users, and in this sense, must be planned and designed accordingly. A service catalog is that compilation of IT services being offered, which is added, modified and deleted accordingly. However, offering the service is not enough, the performance of the service must be guaranteed as needed by the users, and this performance agreement between the users and IT is called the Service-Level Agreement (SLA) which governs the levels of performance for each service being rendered. This will be expounded more under its corresponding subsection, so we park it for now.

In planning and designing for a new service, several questions come to play:

- What need will it address?
- What service level must be guaranteed?
- What is the needed infrastructure? Is it available and should just be provisioned or should it be procured? This may trigger a capacity planning review.
- What resources are needed? (High level) Are they available? By when? How many man-days effort will this be?
- What will be the approximate duration to deliver the service?
- Will this be treated as a change request for O&M to handle or a new project? This would depend on IT's policy. Generally speaking, anything beyond a certain number of man-days or anything requiring a new system or major infrastructure (not just provisioning) would be treated as a project.

Two possible outcomes when designing:

- *Project*. If the number of man-days to undertake the change is significant (depending on policy), then it will be treated as a project and shall follow the normal path for a project (normally outside the scope of O&M); or
- *Change*. In such a case, it will follow the change management procedure as described in the next section.

New services may be the result of a planning exercise or may be due to a request. Take the two following examples:

- The finance department requests for the enablement of on-line payments. In this case, it has been an end-user department to request for the service, the enablement of this service may be treated as a project or merely as a change request to O&M, depending on the effort, complexity, as well as policy for treating requests as projects or changes handled by O&M.
- At the end of the year during the planning session, it was decided to offer by Q2 of the following year a new service allowing customers to view their bill online. This was subsequently treated as a change request which O&M handled.

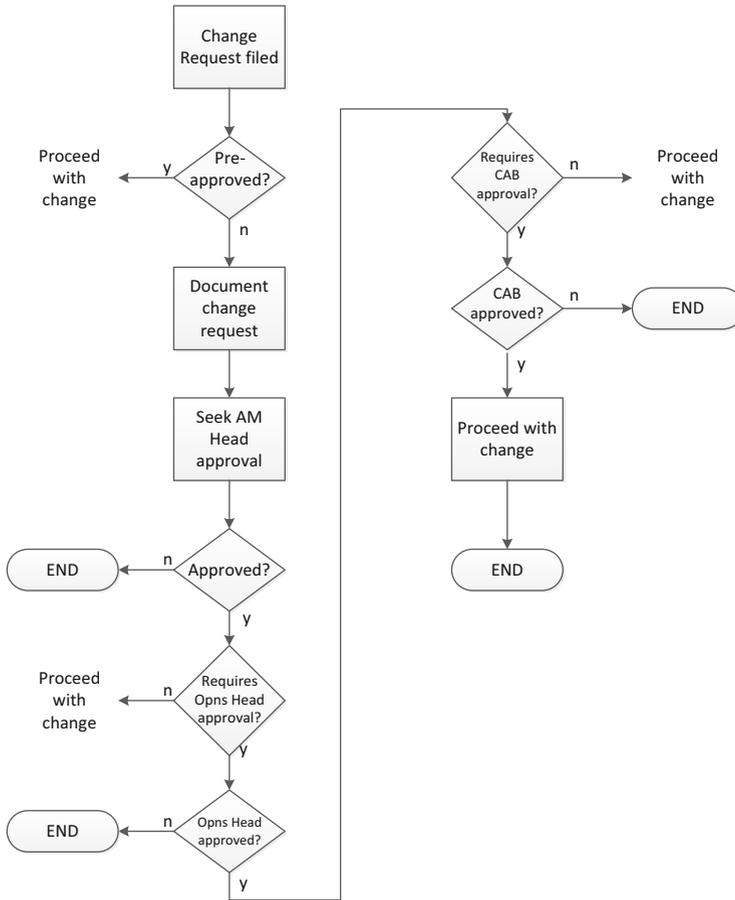
### 4.3.1 Change Management

Change management (Schiesser 2001) refers to the process of changing any Configuration Items (CI) in accordance with a request that may be either initiated internally by IT, or by the user through a request ticket. It defines the process for handling the request for change, while ensuring that the change requests follow proper procedure.

All request for changes normally originate from the Service Desk System in the form of a ticket assigned to a Business Analyst under the AM team (or a TM personnel). The Business Analyst then comes up with a design document which basically records:

- *Reason for the change.* This should be explained in simple, non-technical terms. If the user is initiating the change, then he should be interviewed to understand the reason for the request, and whether this is due to an incident, or is an enhancement.
- *Applications and infrastructure affected by the change.* In other words, this should explain the configuration items that will change. It should necessarily include a non-technical explanation of how the CI will be affected, as well as a technical portion for subsequent reference by the technical team. If the change is at its initial analysis phase, the technical portion may not yet be complete, but will be successively refined. The technical portion should contain information such as:
  - Application affected
  - Module
  - Table and field affected/created/modified
  - Code utilized (if any)
- Initial effort estimated in man-days and type of resources needed
- Information needed by the Change Advisory Board (explained later) should be clear so that approval can proceed without delays. This will include:
  - Change due to request or incident?
  - Impact: companywide/department wide/limited impact. This will include a description of the impact
  - Risk in releasing the change

A change will undergo the normal evaluation and approval process as defined by policy. Approval may be needed from the Change Advisory Board (CAB) (Borges 1984) as explained hereafter.



**Fig. 4.8** Change request approval flow

The CAB is the body which approves/disapproves changes on all Configuration Items that are of primary importance. Not all CI changes need to be approved by the CAB, and would depend on the organization's policy. Changes that are routine and known to have little negative risk can be approved at the lower levels (Operations Head), but if there is an inherent risk in the change or if it has a major impact to the organization, then these shall require CAB approval. The overall approval process may be illustrated by the diagram as shown in Fig. 4.8.

The CAB will usually be composed of the Head for AM, Head for Operations, and if required, the CIO herself, other members may be called to participate as the need arises. Among the aspects evaluated will be:

- Risk in conducting the change.
- Cost of the change (either in \$ terms or in man-hours)

- Need for the change
- Complexity of the change (which normally affect both risk and cost.)

Some of the criteria determining the complexity of the change are:

- Does it affect more than one department?
- Does it divert from standard process?
- Does it necessitate customization (FRICEW)? (FRICEW is explained in Sect. 5.3 but basically refers to customizations on the application.)
- Does it require policy change?
- Does it need approval from other departments (especially important would be finance, legal, HR and procurement)?

On the other hand, factors that are taken into account in evaluating risk are:

- Inherent risk in disrupting operations
- financial impact to the organization
- legal or regulatory impact.
- Changes that require customization. Because customization is an expensive and error-prone process, this is inherently riskier than a mere configuration change.
- Requires Interfaces to different systems, again due to their inherent complexity (and therefore, risk).
- Major changes in master data structure
- Requires access to confidential or restricted data

The CAB may decide to approve, reject or defer the change. Deferment may be just a delay in its deployment, an instruction to seek further clarification from the user/analyst, or a request to consult second level support. This may be due to:

- Insufficient clarity on the possible impact (and risk)
- Insufficient justification on the need for the change
- Insufficient clarity on whether a customization is really needed
- Insufficient documentation

As an example of a request with insufficient detail, take a request lodged for serializing the official receipts generated by the system, wherein the number series depends on geographic location, with no clear indication on why this change is requested, other than this being a finance request. This change has a very large impact and effort, as well as a major risk (affects tax compliance). It was also flagged as a customization, and offhand would seem like a major one, especially taking into account that exhaustive testing would be needed so as to minimize possible negative impact, that has possible regulatory penalty

(continued)

implications. The decision to approve this was therefore deferred pending a more complete explanation on the reason for the need, analysis of its impact, as well as a need to explore alternative ways of doing this without the use of customization.

In the case changes need to be applied urgently, an Emergency Change Advisory Board (ECAB) may be called just for the purpose, and if justified, the documentation may be done after release.

As an example of how the CAB may work, take a request for change involving the modification of the address master to add a special subcategory called “Sub-district” which is nonstandard, and necessitates the use of a table and field in the address master. AM’s Business Analyst suggests the use of a table and field designed for another purpose (Block area). The CAB convened and discussed this at length, this being a customization which involves the use of a standard field but for other purposes. Given this, the CAB decided to disapprove it, due to the possible risk that this field may be needed some time in the future, even if unused today.

#### **4.3.1.1 Prioritization**

As several request for changes will arrive simultaneously, a prioritization should be made at the very beginning when capturing the details of the change.

Prioritization of changes should take into accounts several factors:

- Is it to address an incident or a problem? Or is it an improvement or request from a user?
- Perceived urgency by the line organization
- Possible disruption to Operations in case of not proceeding

If the priority cannot be well-established by the Business Analyst, then it will be escalated for consultation to the AM Head, and if still not determined clearly, to the Operations Head.

Again, highly urgent changes can be routed directly to the Emergency Change advisory board (ECAB) for immediate action, and if very urgent, it may be decided that the corresponding documentation be deferred till after deployment. Take note however that these should be exceptions rather than the rule, otherwise, it defeats the purpose of having a proper Change Management process.

#### **4.3.1.2 Security Change Approval Board (SECCAB)**

In some cases, the CI change may have some security implication that needs to be decided upon; either the requestor was aware of that implication, the IT team handling the assigned ticket, or one of the Heads. In such case, it would need further approval due to the security nature of the ticket, and it would be flagged for

SECCAB review and approval. The SECCAB acts exactly in the same way as the CAB but is composed of at least the ITSec Head, as well as the CIO. Other members may consist of the respective Head affected by the CI, as well as the O&M Team Lead, if needed.

Guidelines on when the SECCAB must be invoked should be clear in the IT policies and guidelines, and all members should familiarize themselves with these.

The SECCAB evaluates the request, first for completeness, and then the reason for the request and whether there is a security risk inherent to the request. It may decide to approve, reject, or give an alternative approach to attain the same final objective.

Typical SECCAB requests that necessarily need to undergo SECCAB approval would include:

- Exceptions to the security policy or its implementing guidelines
- Requests to open firewall ports, both incoming and outgoing
- Requests to connect a server to the internet
- Privileged accounts, be that admin accounts or service accounts with some sort of privilege
- Anything related to CI changes in the DMZ
- Access to production systems by non-SysAd personnel
- Etc.

It is important to note that any attempt at bypassing the SECCAB without getting its approval would imply a grave breach of policy and should be taken against the SLA in a very meaningful manner.

### **4.3.2 Service Level Agreement (SLA)**

Again, the agreement should capture what the users require, and also what IT can provide. In other words, it is useless to target (and invest in) very high service levels, if the users do not in fact require it, while on the other hand it is futile to target very high performance if IT (people, infrastructure, etc.) has not been dimensioned accordingly (nor IT's budget). Take as an example the availability of a reporting system. If this system is not to be used over the weekends, there is no point in targeting 24×7 availability when in fact the weekends may actually be used for maintenance purposes of the application and related components.

The SLA is a covenant agreement between the two parties, and a commitment for IT to provide the necessary performance levels described in it. Common performance metrics used for service level include:

- Availability—indicates the (usually %) amount of time that the application is available for use.
- Response time—the time for the application to return the requested output.
- Correctness—of reports, data uploads (for example, from external systems)
- Resolution time—time needed to resolve an issue

- Timeliness—delay or % of time a particular output is available
- Completeness—usually of documentation that is used in supporting operations such as Knowledge Base documents, work-instructions, manuals, etc.
- Customer Satisfaction—by means of surveys

Thus, all services must be designed according to the agreed-upon SLA, which means that all the different components needed in order to deliver the necessary service level must also be designed accordingly. Thus, for response time, resolution time and other metrics which use time, the following calculation is used:

$$\text{Total time for delivery of the service} = t_1 + t_2 + t_3 + \dots + t_n$$

This means that the total time for delivering the service is equal to the sum of each component. Similarly, the overall availability will depend on the product of each individual's availability component:

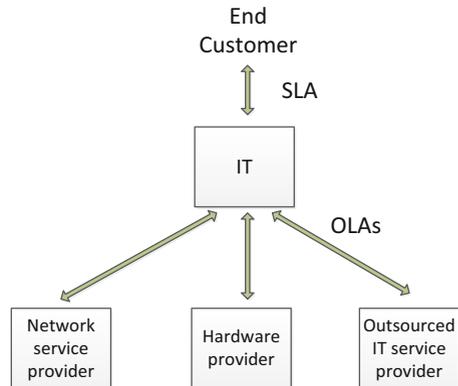
$$\text{Overall availability for the service} = A_1 * A_2 * A_3 * \dots * A_n$$

The formula above is applicable when non-redundant/nonhigh-availability components are used. Thus, for example, the overall availability of the financial management system will be the resulting availability of the product between the availability of the network, availability of the servers, availability of the storage, and availability of the application itself. On the other hand, its response time would be the response time of each individual component: network (summation of each switch's latency involved in the routing), server response time (application server, database server), and other components utilized.

The service catalog is thus a list of services that is provided to the end-users as defined in the SLA between IT and the users. It is imperative that this SLA be presented and approved by higher management, as it comprises of IT's commitment to deliver. As services change with time, the service catalog needs to be updated by adding services, deleting them, as well as updating the SLA based on new requirements, changing strategy, or changing environment.

IT in turn may be contracting several parties to undertake the services being delivered. As such, these subcontracted services need to also commit to certain service levels that conform to the overall SLA. These underlying contracts are thus governed by a similar mechanism, but are called Operational Level Agreement (OLA) which should be more stringent than the overriding SLA so as to allow IT to meet the SLA commitments with some buffers.

Suppliers that may form part of the delivery of the agreed services includes outsourced service providers, hardware maintenance providers, network and telecommunication providers, software developers, and the like, and each should have its OLA governing their services which should tie-up to the overall SLA. This is shown diagrammatically in Fig. 4.9.

**Fig. 4.9** SLA vs. OLA

## 4.4 Release Phase

The release phase refers to the different tasks and aspects that need to be undertaken before and during the release of the change into production. This release may be a new service or a change to an existing service.

A change must be managed properly, in that it:

- Be conducted with the right quality, time and cost
- Have minimal unpredicted impact on production
- Reduce errors and minimize risks due to transitioning to the new or changed services

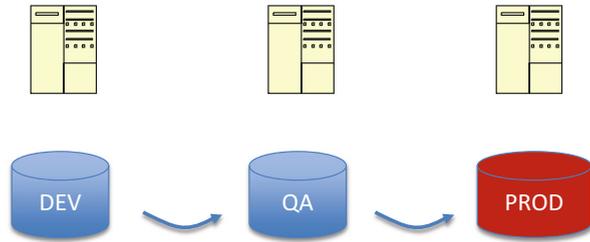
Any change undertaken means that a corresponding configuration item (CI) has changed. A configuration item refers to any asset, service component or other item which needs to be controlled in order to deliver a service or services. Thus, any deviation from the baseline situation is considered a change that has to undergo proper release management.

In order to minimize the impact to production, releases must be tested thoroughly and properly before release. This means that aside from the production environment, proper development and testing (also called Quality Assurance) environments should be used, and this brings us to the topic of testing.

### 4.4.1 Testing

Testing is explained more exhaustively in Sect. 5.5; however, there are some basics of testing worth mentioning here. Firstly is the need to have separate environments for Development, quality Assurance (Testing) and Production. Under absolutely no circumstances will any releases be done directly into the production environment without prior testing in the QA environment, while at the same time, all changes are

**Fig. 4.10** Typical release lifecycle



to be initiated in the DEV environment. The diagram in Fig. 4.10 depicts a typical release's lifecycle.

A typical change is initiated in DEV by the Business Analyst and/or developer, and unit testing is undertaken here. If successful, then the release procedure is called (and executed by TM) so that the change is now released into the QA environment, where he will proceed with a more exhaustive testing (unit testing, regression testing, integration testing, and whatever else has been determined to be necessary). If and when it passes all these testing by the Business Analyst, he may then call (depending on the type of change) for the users for their round of testing. As a rule of thumb, users should generally be called for them to test when:

- They were the requestors for the change; or
- They are the ones commonly using the said transaction or function; or
- Involves transactions too complex for IT to understand or recreate due to unfamiliarity with the data, or manner in which the transactions are to be conducted.
- If unsure, the best rule is that it be the end-users to test

In other words, since the users are the experts in using these transactions and measuring their impact, they should be the ones to determine whether the change has been successful or not. Failure to involve the users during testing can result in grave consequences.

Take as an example a report produced with written-off accounts. This report was requested by finance for use by different departments including sales, however, the rules of how to write-off the accounts necessarily needs to come from finance, as they are the only ones capable of attesting to the veracity and accuracy of the reports, and also have intrinsic authority in officiating these reports.

Once all testing has passed in QA, then the final release to production may be initiated, this has to be in accordance with the plan determined, especially if there is downtime involved.

It is TM that actually undertakes (executes) the release, but it is normally AM and ITOM (or projects) that initiates the request for release into QA, PROD. From the description of how the different environments work, take note as well that normally:

- *DEV*: contains all changes that were initiated, regardless of whether these were released, were cancelled, or were deferred. For this reason, it is important to have a backup of the configurations stored in DEV. The data however is relatively irrelevant, as it is usually scant and created by the testers only for the purpose of simple unit testing.
- *QA*: should be a reflection of *PROD* in terms of configuration (except for those changes in QA pending release to PROD). It should normally contain data that is quite similar to PROD for testing purposes, and this is why many times, the data from PROD is copied regularly into QA, so as to maintain it current so that the testing can be more accurate.

There are several risks in having DEV and QA not properly maintained. Consider the following problematic scenarios:

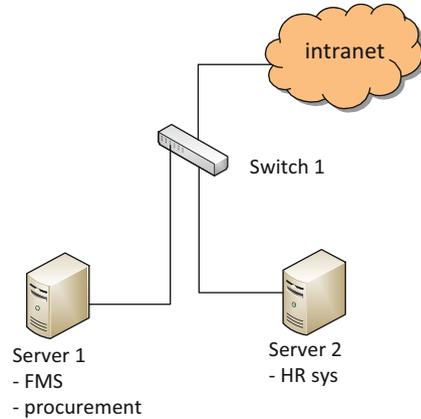
- *QA does not have some of the Configuration Items that are in PROD* (aside from the CIs being tested): that means that the testing environment in QA does not reflect the same as PROD, which defeats the purpose of testing, as you wish to test in an environment as close to as possible to PROD, before you release into PROD. This has the implication that although testing may pass in QA, it may ultimately fail in PROD.
- *Data in QA is very old*: data, same as CIs, affect the behavior of the environment. Though it is impossible to have all PROD data in QA at any given time, the data in QA must be refreshed periodically so that the environment stays relevant (and similar to PROD), to make the testing effective.
- *CI in QA did not come from DEV*: In this scenario, the QA was properly configured directly without it coming from DEV. This means that the development package is not tracked (it should always originate in DEV) and may be lost in the next QA refresh. Ultimately this means that something in PROD will not be reflected in DEV and QA which may cause errors in the future. Furthermore, these CIs will be hard to trace and if and when identified, will need to be manually reproduced in DEV, and subsequently released to QA.

#### 4.4.2 Configuration Items

As explained, changes mean modification on configuration items, where configuration items mean the details on the setup of an application, system, or asset to deliver an IT service(s). Examples of configuration items are:

- *Server*: the operating system used, patches and versions applied, memory, number of CPUs

**Fig. 4.11** Example for a switch and the effect of a CI change



- *Network switch*: operating system used, its version, firmware version, Network Access Tables, number of ports, connectivity of the ports to other devices, etc.
- *Application*: the different modules, tables with their configuration entries, custom programs used, tables and fields in the DB, etc.

Configuration Item changes must form part of the documentation produced during the planning and design phase, and must be updated subsequently if any additional changes are made. It is also important to note that Configuration Item changes have the effect that they may in fact affect more than one asset, so that the impact of such changes need to be analyzed and tested thoroughly before actually releasing to production.

As a particular configuration item may affect many different assets or services, the relationship between configuration items is to be recorded in a so-called Configuration Management Database (CMDB) (Michael Brenner 2006; Axelos 2011). This database records the relationship between all the different configuration items.

An example of a configuration item change that affects others is shown in Fig. 4.11, which depicts a network switch attached to several servers.

Any change on Switch 1 (say the routing rules) therefore has a potential impact on server1 and server2, which in turn have a relationship to the FMS and procurement systems, and the HR system, respectively. Thus, ideally this relationship between the switch and the other assets should be captured (as part of the CMDB), along with the properties and characteristics of each component.

### 4.4.3 The Configuration Management Database (CMDB)

A Configuration Management Database (CMDB) refers to a record of all Configuration Items (CI) for the company, meaning, all assets and their respective configurations as well as their interdependency with other assets and in turn their own CIs. As an example, a software called “Easy software” version 1.2 is related to

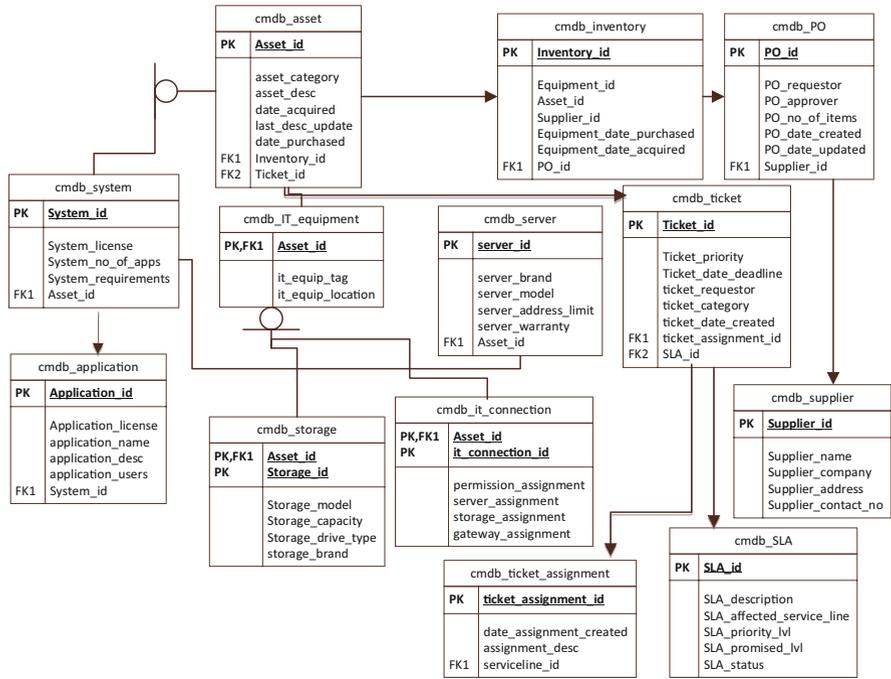


Fig. 4.12 Sample CMDB logical structure (partial structure only)

other assets, for example, the server it resides on, a Dell PowerEdge R220 Rack Server, the O/S it is running on, Windows XX, the DB which is MS-SQL XX, and so forth. These assets by themselves will carry more details, such as the MS-SQL XX, which would have information on its version, patches applied, etc. Relationship between assets may be quite complex, as for example in the case where we have a switch connected to several servers, the connection between these assets needs to be captured as well.

CMDB for the longest time has been a panacea and has been tracked by means of manually recording this information. However, new tools are now available in the market which allow for the “auto discovery” of these assets. CMDB software scan servers, network, as well as endpoint devices to display the interrelationship between them, and the CIs for every asset.

In its conceptual form, the CMDB is a logical representation and relationship between services, assets and the infrastructure and which records the relationship between configuration items. This is conceptually shown in Fig. 4.12.

In many cases however, the CMDB will not be a one and unique central repository, because for all practical purposes, different tools will be more efficient in discovering different types of assets:

- *Network Management system (NMS)*: will act as the CMDB of all network-related assets such as switches, routers and the like. The NMS' CMDB is in fact just a subset of the NMS' main function, which is to manage the network seamlessly from a single console.
- *Endpoint Device Management System*: system that manages the endpoints (mainly PCs and laptops but nowadays also tablets and smartphones), and deploys patches and upgrades to them.
- *Mobile Device management system*: This is an endpoint device management system specific to mobile devices (e.g., tablets and smartphones).
- *Asset Management system*: may encompass some of the above functionalities but additionally also servers.
- *Excel sheets*: these may have information on the above (especially if no system is used for them), additionally, contractual and supplier information and maintenance information (such as when it will expire) will be stored here.
- *Integrated CMDB software*: in which all the above functions are encompassed by means of auto discovery agents.

Benefits of a complete CMDB are:

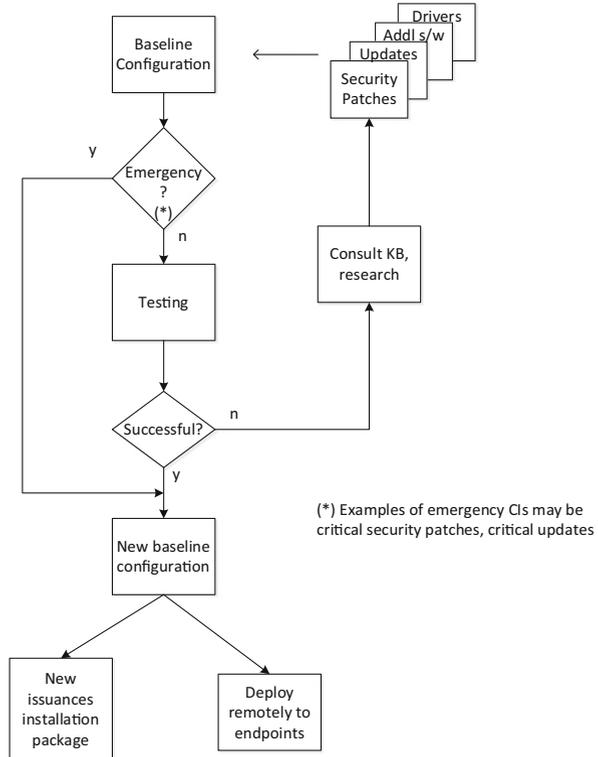
- Easier troubleshooting
- Easier renewal of maintenance
- Management and control of licenses
- Easier release management and impact analysis

Again, pros and cons need to be evaluated in determining the extent and depth in which to deploy a CMDB solution.

Another important and related concept is that of the Baseline Configuration. A configuration baseline is defined as the configuration of a service, product or infrastructure that has been formally reviewed and agreed upon, and that thereafter serves as the basis for further activities that can be changed only through the formal change management procedures. A configuration baseline can be obtained for most assets through a "snapshot" of their CIs at a particular moment. This may be done manually if the number of assets is small, but this quickly becomes unmanageable, so that the asset discovery tools described earlier may be needed in order to display the different CIs.

Special mention needs to be made for endpoints (laptops, PCs, tablets and smartphones). These, if company-issued are also managed by the company, and as such, it is the desire of IT that they all have the same deployments and configuration. Whenever new units are procured, these should be deployed with their corresponding baseline configuration before issuance. As such, it is the task of the US group to regularly update these baseline configurations so as to ensure that new issuances are updated with the latest patches and versions of the software. Before these are made part of the new baseline configuration, they may need to be tested so that no issues occur to the users as shown in the diagram of Fig. 4.13.

**Fig. 4.13** Endpoint baseline configuration deployment workflow



A similar yet more limited approach may now also be undertaken for servers, thanks to virtualization technology, allowing for the fast provisioning of servers.

Let us now go back to the switch example used in the previous Configuration Item section. For the CMDB, the switch, its brand, ID, model, firmware version, O/S version are important and should be captured, together with the specific configuration of the switch. At the same time, the relationship with each server, including the port in which it is connected and the characteristics of the port (number, speed, etc.) should also be captured. Any modification of the switch from this baseline shall call for the change management procedure.

Service Assets refers to different tangible and intangible resources and capabilities that the IT organization owns and uses in delivering the different IT services. They are the value the IT organization possesses in creating a greater value (IT service).

IT Assets may be of differing forms:

- Management
- Organization
- Process
- Knowledge

- People
- Information
- Applications
- Infrastructure
- Financial Capital.

Configuration Management (Watts 2011) is a sub-set of release management that delivers a model of the services, assets and infrastructure by recording the information about components (Configuration Items), the relationship between these items, and how these will change based on the release. This enables other processes to access valuable information, such as the impact of proposed changes.

The main asset or system for this purpose is the so-called Configuration Management Database or CMDB.

#### 4.4.3.1 Release Approval

Part of the approval may also involve determination on the right moment to release. In some organizations, specific weekly or daily windows for releases may have been defined, especially if there is downtime or risk of conflict.

Regardless of whether such a window exists or not, the planning should take into account the timing for the release:

- Downtime (if any) for the release, and how this will affect the users
- Locking-out of certain users and transactions, if necessary
- Transactions that may “hang” due to the old process not being accessible or possible after the change. It is important to identify the best time to release, so that the number of “hanging” transactions is minimized. It is also important to identify what the proper procedure for the hanged transactions should be, whether:
  - These may be left hanging
  - These need to be deleted, and by whom (system administrator?)
  - Needs direct configuration into the DB (very risky! Should be minimized)
  - Needs a special procedure
  - Need to be manually cancelled by the user, and re-created again after the release of the change

To illustrate the situation of a hanged transaction, take for example a self-service HR system in which employees file their leave requests. Because of a change in the leave request process, all the old requests with pending approval or cancellation before the release result to be hanging and do not proceed for approval in the system. As such, users need to be advised on what will be the effect and action to take. For example, they may need to refile all these leave requests that remain pending approval after the release. To fix this, a typical procedure may be:

(continued)

- System administrator cancels old transaction
- HR informing the users to recreate
- HR informing the approvers to re-approve

Depending on the release, if it affects many users, this may necessitate a cut-over plan taking into account:

- Testing and even pilot release (if applicable)
- Advisory to affected users
- FAQ to Service Desk for easy and speedy resolution of queries and incidents
- Training (if any)
- Hand-holding for special users
- Back out procedure

In a way, this is a mini version of the cut-over activities during project deployment as described in Chap. 6.

The manner of the release is dependent on the type of application and what type of release management it supports, as each has its own release strategy, and may vary from the primitive to the sophisticated. Different ways releases are managed from one environment to another area (in accordance with what the application itself supports):

- *Manual*. Such that changes made in one environment need to be manually configured in the one being deployed to.
- *Copy of the configuration file* from the current to the deployed environment. This is for example used by MS Dynamics.
- *Releases are deployed by means of a tool* within the system to the target environment without generally causing any downtime. Example of this is SAP.

Furthermore, some releases necessarily need to be done manually (many technical items, for example, as well as some master data in some systems), so the possible impact of the release needs to be assessed well before undertaking. A more exhaustive explanation of release management is in Sect. 7.8 as explained under projects.

#### 4.4.3.2 Documentation and Knowledge Base

All releases need to be properly documented in terms of what they are, how they have been undertaken, and the reason for the change, among other details. Two types of releases:

- AM-related releases which refers to CIs of the applications
- TM-related releases which refers to CIs for the infrastructure

Each has its own type of documentation. The knowledge base documentation for AM-related changes would generally comprise of two components:

- *Business requirements document*: describes the user's requirement that triggers the change request. This document will be needed only when the user's request contains some degree of complexity which necessitates a document describing these requirements with some degree of depth, otherwise, a simple description in the body of the ticket will suffice. This document needs to be signed off physically or electronically by the requesting user before proceeding with a more detailed analysis.
- *Request for Change Functional Specification*: this is a mandatory document which among other things contains:
  - Translation of business requirements into a language that the BA understands in order to configure, rationale for the change, as well as other relevant information.<sup>(\*)</sup>
  - Would contain specific fields describing how it has to be undertaken, depending on whether this is a:
    - Report
    - Interface
  - Technical specifications
    - System affected
    - Module involved
    - Program or object name affected
    - Description of program or object name
    - Type, such as:
      - Java
      - ABAP
      - .net
      - Others
    - New/modification
  - Configuration description, including code affected, parameters and description
  - Database modification, including:
    - Table name
    - Fields affected
    - Details on the changes or configuration on the fields
  - Data modification: this is if there is a direct data modification that needs to be undertaken
  - Should include screenshots and other information that describes the issue, limitation or other information that needs to be addressed.<sup>(\*)</sup>
  - Registry of effort involved in undertaking the change.
  - Signatories<sup>(\*)</sup>
- Release to production information form<sup>(\*)</sup>. Shall reference:
  - Release code (if any) for audit trail purposes
  - Ticket information

- Date
- Other relevant information for the release to be tracked
- Test plan and test scripts with results<sup>(\*)</sup>

Those marked above with (\*) are mandatory, the rest are dependent on the type of change being requested.

For TM-related changes, three general types:

- Incidents
- Problems
- Requests

In all cases, if the configuration needed is simple, then an explanation in the ticket itself of what is to be done is enough. For more complex requests, a Work Instruction-level procedure needs to be produced describing how the change is to be executed.

For simple incidence resolution, description of the resolution in the ticket may be sufficient. On the other hand, for complex issues and for problems, several actions may be tested before the final resolution is attained. As such, all these attempts and work-arounds need to be documented at the work-instruction level into the knowledge base. All incidences related to the same issue will then be referenced to the problem ticket and the KB document, which should also contain the list of other incidences related to it that were raised.

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## 4.5 Maintenance Phase

The maintenance phase refers to the day-to-day activities that are conducted in order to meet the defined Service Levels. This normally means:

- Managing the infrastructure so that it is performing according to its required service level
- Running the different batch programs that are needed in order to produce the intended outputs
- Receiving and processing any requests for changes
- Analyzing and proactively managing events detected
- Managing and resolving any incidences detected/reported

For infrastructure, the following specific aspects also need to be addressed:

- Capacity management
- Availability management
- IT Service Continuity Management
- Information Security Management

These are explained in detail the next sections.

Normal service operations need also to take into account the following processes:

- Event Management
- Request Fulfillment
- Incident Management
- Problem Management
- Access Management

Let us now discuss each of these separately.

### **4.5.1 Event Management**

Events refer to some condition which require attention and may also be called alert. It may be generated by an IT Service, Configuration Item or Monitoring tool. It is not yet an incident, but may lead to one, and thus, a request ticket may be opened to address this, or a request ticket must be raised for investigation of the event.

Examples of events are:

- Disk has reached 80% threshold—the capacity management monitoring tool for the disk determines that the disk will reach full capacity in 3 months; it thus raises an alert so that it is properly addressed.
- A batch process failed to finish within the usual 3–4 h runtime, though it did finish without incidence in 6 h. The IT Operations Management team may raise this for investigation, as this could repeat, or worse, further deteriorate.
- The configuration of a server was detected by TM to be incorrect. The data being downloaded is being written into c: drive, which is normally reserved for the operating system. This is not causing any issue at the moment, but is an event that can eventually cause issues in terms of capacity management.

Events, once detected, need to be investigated and/or addressed by the corresponding team. Root cause of the problem needs to be evaluated, and the team will subsequently release a request for change to address the issue. Thus, an investigation ticket or a change request ticket may thus be raised to analyze or address the event, as the case may be.

Events, if they cannot be addressed immediately, may also form the basis for the continual service improvement, so that they be eventually addressed.

### **4.5.2 Incident Management**

Incidences are events that actually disrupt a service from normal operation and service level. Incidences may be raised by different entities:

- Users when they detect the issue
- Any member of the operations team as well, when detected
- IT Project members that report an issue that is already under operations' responsibility

Incidences that are reported should be resolved within the timeframe as specified by the SLA. These may be treated generically (all type of incidences) or specific (depending on the type of incidence). The most immediate concern when an issue is opened is in restoring the service to its original level. This means that if the root cause may take time to be identified, work-arounds can be applied in order to do this, while the root cause is still being sought for. All these actions need to be necessarily recorded in the knowledge base (see later section), so that it be a clear reference on what were the actions taken, including work-arounds, what the root cause is, and the final resolution. Incidence tickets should not be closed until the proper knowledge base document has been produced. Take note that if the incidence's root cause cannot be identified, a problem ticket may need to be opened, as is discussed later. This allows for an in-depth analysis of the root cause, as problem tickets are not time-bound till resolution. All incidences related to the same problem ticket will be tagged as such, so that the problem ticket references all the associated incidence tickets.

Take an example of a reported incident from a user which cannot log on to the different corporate applications as the login via Active Directory does not work for him. As these cases were encountered before, SD instructs the user to lock his screen, and after a few seconds attempt to login again. If this fails, he is then instructed to restart his PC, which again fails to resolve the issue. It then becomes a problem, as this situation has not been encountered before and needs further investigation to pinpoint the underlying issue. As the user however, cannot be kept hanging without his access, a work-around is effectuated, in which his PC is whitelisted in the Active Directory, allowing him access to all the different systems. In this case the incident ticket is closed, but the problem ticket remains until root cause is identified.

Incidence tickets normally carry different weights depending on their severity, major incidences are those that:

- Have a high potential business impact
- High urgency
- Impairs many business units

This is also explained under the Service Desk section. Severity should be identified at the point of capture, which is normally Service Desk, major tickets would have a higher priority for resolution. Service Desk will also collapse several reported incidences into a same one if they are in fact one and the same, but reported by different users.

Incidence tickets will then be routed using their pre-defined escalation procedure, to the correct Service Team for analysis and resolution. All incidences will remain open until such time they are resolved (totally or by means of a work-around), or if cancelled. Cancellation of incidences may be due to the realization from the user that it is not a true incidence (he undertook the wrong procedure, for example), may have been discovered by the service team to be due to wrong procedure or data, or simply that the service was restored to its normal condition without any action (as it sometimes mysteriously happens! However, this is usually due to wrong user procedure being used).

### 4.5.3 Problem Management

Problem tickets are always the result of an incident or several incidences. In other words, an incidence is first detected and attempted to resolve, but then a problem ticket is created when:

- Many incident tickets of *differing* nature result, but are due to the same underlying root cause. For example, a network problem related to a faulty switch causes different type of incidences including slow response time, unstable network and unreachable servers.
- The root cause is not known beforehand nor is it resolvable within a reasonable period of time due to its complexity (it does not appear in the Knowledge Base)
- May require the analysis, involvement and participation of many of the service lines, not only one.

Problem tickets may be opened by any service team that is in charge of the original incidence ticket(s), and this will be automatically assigned to the team creating the problem ticket. Though the service team may require involvement and assistance from other units, principal responsibility still resides with the team handling the original incidences. Several steps may be taken from this point forward:

- Attempt to recreate the problem. Sometimes the most difficult incidences are due to the fact that they appear randomly or in circumstances that occur infrequently. If there is a sandbox environment, the team may attempt at recreating the incidence and then analyze logs, variables, etc. to try and identify the root cause.
- If the problem is related to a customized CI, then most likely this is due to the way the customization was done, so the first step is to analyze this CI's programming and related configuration.
- Consultation of internal knowledge base. This is to ensure that no similar incidence occurred in the past, which may give clues to the current problem.
- Consultation with the supplier's knowledge base and forums. To check if such issue was encountered before, and as to resolve faster.
- An incidence ticket may be raised to the hardware or software provider. It may be determined that the root cause is due to a bug or faults from the provider, so that

once enough information is collected, it is then escalated to the provider's technical helpdesk for analysis and resolution. The Service team may also be unsure if it is indeed due to the provider, but reasonable suspicion warrants the raising of such a ticket to them at the earliest possible time.

- If still there seems to be no resolution after the steps above, a more lengthy analysis may be needed. If the problem ticket is of certain importance, the operations team may invoke the involvement of specialists, either from the provider or from external consultants, so as to resolve the issue.

Once the possible resolution has been identified, this shall undergo the regular change management procedure including testing and identification of roll-back procedures.

As explained for incident management, problem management needs to first and foremost address the issue of restoring service to its normal level. This means that while the root cause is being identified and addressed, a series of work-arounds may be applied in the meantime. It must be ensured however that such work-arounds do not mask the issue from being resolved permanently, or in other words, does not hamper the investigation into the final root cause of the problem. Common work-arounds are:

- Restarting of the server or router (an all-time favorite of IT teams)
- Restarting of a service
- Rerun
- Rerouting of network switch
- Roll-back of a change
- Work-around procedure to address the issue
- Data modification

Again, it must be emphasized that these are only work-arounds and should not be abused. Restarting of a server is really a very bad way to address an underlying issue because it just temporarily defers the issue. Take for example the case in which the server is swamped with transactions that eat-up its resources, causing it to eventually fail or slow down to unacceptable levels. Of course resetting the server frees-up the server's resources, but only temporarily as it has terminated all processes handled. The root cause may actually be insufficient capacity or the incorrect utilization of the server by an application.

It is important that all work-arounds, successful or not, be recorded in detail in the Knowledge Base for future reference. If a similar incident occurs again in the future, it will then be easy to know and apply known good work-arounds, while avoiding those that are known not to work. All errors which have been resolved and are recorded in the Knowledge Base are referred to as Known Errors.

#### 4.5.4 Request Fulfillment

Requests are tickets that are also filed through the Service desk, but unlike incidences and problems, are not considered issues, but form part of normal operations. Requests will have their own SLA, distinct from that of an incident. Generally speaking, not all requests will be treated equally in terms of priority (see Service Desk section) but will depend on the type of user, type of request, and as will be discussed here, the service line affected.

Requests related to TM, ITOM, US are usually straightforward to fulfill and can be met relatively fast (unless requiring field work), requests for information should also be straightforward, however, requests related to Application Management can be quite complicated in nature, especially if this involves the request for a totally new configuration or functionality in a particular service. Such requests will typically give rise to a request for change, which, as it may need sufficient man-days of work, will need a fulfillment date that is agreed upon with the requestor. Typical steps for fulfillment are:

- *Pre-analysis of the request.* Will be determined by the corresponding AM business analyst. Will first determine if the request cannot be met by any existing function or procedure, and whether it warrants opening a request for change. The business analyst will also determine whether the request needs to go through CAB or ECAB, as per IT policy. Depending on the gravity (urgency), it may already be raised to ECAB for approval, even without full documentation of the requirements.
- *Analysis of the request.* Once validated, the business analyst shall proceed with the detailed analysis and design of the request. He shall coordinate with the user in filling-out the design specifications documentation to ensure that the request's scope and details are captured correctly and entirely. This may entail:
  - Request for further information from the user by email
  - May require a sit-down meeting with the user
  - Once the design document is filled-up, a sign-off will be needed from the user. This signifies the correct capture of his requirements. This document will also contain details such as man-days estimate and resources required, tables, fields and objects used, as well as details on the customization (if any). Nothing should proceed after this unless sign-off is obtained.
  - CAB approval if required. If not, this will follow the normal ticketing procedure for approval process.
- *Execution/Build*
- *Testing*
- *Deployment*

These are the normal procedures for release management (see pertinent Sect. 4.4).

Some examples of different type of requests and their escalation and approval level are:

- Request for internet: approved by user's Department head
- Request for installation of a software existing in IT's catalog: pre-approved
- Request for transfer of files from old laptop to new laptop: pre-approved
- Request for access to the ERP: approved by his Department head/Business Process Owner or both
- Request to install a new trial software: approval by the II Head
- Request for a project: approval by the CIO

These approval levels are best configured inside the Service Desk, so that depending on the category, the ticket is escalated to the correct approver automatically.

More of this explained in the next section.

### 4.5.5 Access Management

Access management is the process of granting authorized users the right to use a Service (including data or an asset), while preventing access to non-authorized users. Access management may be grouped into two general categories:

- *Pre-approved*: in which access can be granted to the requestor immediately by the Service Desk due to his position or role, as the access being requested is pre-approved as per IT policy.
- *Requires approval*: again, the basis is policy. Approval may not only be from IT, but may also require approval from the line organization to which the user may be reporting to.

As an example of the first, say that company policy is to grant email utilization to any company employee, as such, a call from an employee requesting for email service is automatically granted by the SD. The SD then creates a ticket which is routed to the corresponding service team that will physically create the account. Supposing now that company policy is to restrict the use of social networks unless properly justified and approved by the user's department head. An employee filing a request for the use of twitter ("X") would therefore have to seek his department head's approval before the request proceeds.

Some services may be quite complex and authorization on their use may not be apparent. This may be the case for example when requests for certain functions or roles in an ERP or a CRM system. Data may be confidential and should only be accessible to personnel with certain roles. As a best practice, there should be Business Process Owners (BPOs) defined for each major process, and these should be the ones to determine whether authorization should be granted or not. A Business Process Owner (BPO) is a role given to certain key users in the organization, their duty is that of caretakers of a process(es) which they are accustomed to as they

normally either execute this process or are the managers of people who are the ones executing these processes. He is expected to know the process very well, including its intricacies, limitations, and find ways of improving it. In effect, IT is the entity that implements the process, but the relevance and use of the process is something the BPO is in charge of. These persons should regularly coordinate and meet, together with IT, to see what more can be done to improve the efficiencies of the processes; they are also in charge of the data that these processes produce.

As an example, take the head of Customer Service who is the identified BPO in charge of the CRM's customer data. A request from a user within the organization to access customer data in the CRM may only be authorized by the BPO after careful justification. The justification may be apparent, as for example, due to the position or role of the requesting user, but in cases it is not, he may have to explain why and what data he needs access to.

### 4.5.6 Capacity Management

This refers to the ability of the different components of a service to have sufficient capacity to deliver a service with the agreed performance as defined in the SLA. This is commonly thought of for infrastructure, but also holds true for human resources. Capacity management as a process refers to the continuous planning, monitoring and adjustment of available capacity in order to meet the overall SLA now and in the future.

- *Planning*—refers to the initial definition and allocation of resources needed for the service. Common type of infrastructure capacity applies to servers, their memory, CPUs, as well as disk size, network bandwidth required, as well as particular skills (people) needed to keep the service running. Capacity planning may be initially designed on a per service requirement, and then rolled-up to a total which will define the total capacity needed by the organization.
- *Provisioning*—in which specific assets and services are assigned specific resources.
- *Monitoring*—in which the different resources' utilization are observed during normal and peak operations in order to detect if any saturation occurs, which may impair performance.
- *Tuning*—in which additional resources may be added and configured until the desired performance is attained
- *Procurement*—in case no additional resources are readily available, then the procurement or availing of additional resources from external suppliers triggered. Alternately, resources may be reallocated from services or assets, if possible.

Capacity management used to be a difficult endeavor in the past, but due to the rapid advancement of current tools, work has been made easier:

- *Capacity management analysis tools*—these is a wide array of tools available to analyze allocated resources vs. current performance. These monitor CPU, memory, network and disk storage utilization. Some of the more advanced tools also have predictive capabilities, in which they predict when certain resources will fall short based on current trends (for example, hard disk based on current growth).
- *Virtualization*—previous to virtualization, hardware resources were all physical, nowadays, with the advent of virtualization and cloud technologies, resources can be allocated on-the-fly as the need arises, without the need to wait for the lengthy procurement and delivery processes to finish.

Capacity management reviews should also be called for regularly, so as not to be caught unaware on the capacity situation, pre-empt requirements and procure additional assets if necessary.

### 4.5.7 Availability Management

Availability is the ability of an IT asset or IT Service to perform its agreed Function whenever called for. It refers to a general indicator of the % of time it is available for use vs. total time. Take note that when we refer to available for use, it does not mean actually used. Also, the total time to be used in the denominator of availability refers to the total time *DESIGNED* for use.

As an example, take a certain service which is to be up and running 8×5. Thus, during the week hours of every working day, it should be up and running for use, even if it is not actually used. If there is downtime during the weekend, this does not matter, and is not counted against its availability because it was not designed for use in the weekend.

As such, it is of no use to overcommit on the availability (and thus, overcommit on resources) if it is not actually needed; resources are to be allocated only according to the expected service levels as per their availability metrics, which should in turn reflect reality and expectations for the service using them.

Though it may be obvious, availability must also factor-in downtime required for maintenance and upgrade, and this includes time needed for patch updates, DB and OS upgrades, application upgrades, etc.

Additional metrics that may be relevant are:

- *Reliability*—refers to the ability for a service or IT asset to perform without interruption. This can be measured by the Mean Time Between Failure (MTBF) or Mean Time Between Service Interruption (MTBSI). Depending on the case, this measure may also be important and not just availability, as the service may be so critical that it needs a guaranteed reliability measure. As an example, take a particular service, say an ftp server that is expected to be up 99% of the time (availability) which is actually met. However, this service has repeated disruptions, each of which lasts very few seconds so that the even if the total availability is met, its reliability is very low. Because of the frequent disruptions,

very large file copy transactions to the server are disrupted and do not finish, so that these need to be restarted again. In this case, poor reliability has a direct effect on the service.

- *Maintainability*—A measure of how quickly and effectively an IT asset or Service can be restored to normal working condition after a Failure. This is commonly measured using Mean Time to Restore Service (MTRS).

Availability and related metrics in general depend on a number of factors:

- *Adequacy of resources allocated to the different CIs*—say for example, memory, CPU, network bandwidth and hard disk must be sufficient for a server to conduct its functions correctly. Incorrect sizing will degrade the performance of the server to levels making it slow and eventually, unavailable. The same holds true for human resources, in which sufficient levels (number of man-hours) of properly skilled resources should be applied to keep it running. For example, DBA hours needed for tuning the DB, as well as time for applying patches to the applications as required.
- *Redundancy*—This may be used to increase the availability of the CI and service. Common practical redundancy measures includes clustering, having redundant application servers, redundant network path links and switches, and a multi-skilled workforce.
- *Spare*s—may be used to increase the in general, having spares is a second level approach needed to meet the availability requirements. By having spares, maintainability in the form of MTRS will be relatively lower (vs. redundancy). Again, with today's virtualization technologies spare servers can be restored in a very fast fashion. With cloud technologies, restoration is not only fast, but also at a fraction of the cost of having procured the spare altogether.
- *Backup*—is also a second level approach, which ensures if something goes dramatically wrong, the application and data can be restored in the fastest time possible. Backups can be done in a variety of ways, and is explained further in Sect. 4.5.10.
- *Third party High availability spares*—is a third level approach, in which, instead of having the spares on-hand and having procured them, a service contract is signed with an external third party for them to provide the spares on an as-need basis, in which the third party guarantees its particular availability of spares and time to restore. These third parties are either resellers/distributors of the product, or companies specializing in these kinds of services, and normally charge a % of the actual cost of the spare. Spares may be new or refurbished, the last especially true for outdated technologies.
- *Security*—security breaches may cause downtime, some of them significant, so that security must be properly addressed. More of this is discussed in Sect. 4.5.9.

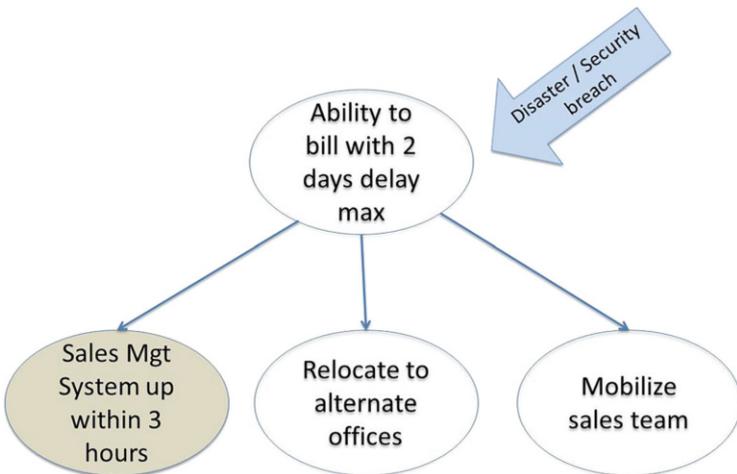
Poor availability is usually the first sign of poor IT practices, and the most obvious shortfall from a user's perspective, and yet, if bad practices have been

running for a long time it is also difficult to address, requiring cultural change and time for them to take effect.

### 4.5.8 IT Service Continuity Management

This refers to the management of risks that could seriously impact and impair IT Services. In other words, it refers to the ways and means to reduce risks due to force majeure (usually natural calamities) that could impact severely on the ability to provide the required services. Some important related concepts need to be kept in mind:

- *Business Continuity*—Overall business needs to ensure continuity of service in case of disaster or security breach. Since IT is well and part of the normal operation of a business, it needs to be aligned with the business requirements. As an example, if the priority of the business is to be able to keep invoicing even if in times of disruption, but it is acceptable for functions related to human resources to be impaired somewhat, then the IT services must take this into account. It is of no use to over-allocate and over-meet the overall expected service level, as this has a cost implication. IT’s SLA must be aligned and support the overall service level of the business. The diagram of Fig. 4.14 shows an example of an interrelationship between the overall business service level and IT’s in case of a disaster.



**Fig. 4.14** Example illustrating relationship between corporate business continuity and IT service continuity

As you can see from the above diagram, the IT portion is just part of the overall business continuity plan (shaded globe) but an important component to meet the overall (impaired) SLA.

- *Risk Analysis*—a risk analysis should be made for the purpose of identifying possible impact the risks may have, and the probability of the risk. This should again be done preferably at the corporate level first in order to identify what its perceived risks are, and then perform this same exercise at the IT level. At the business level, not all the risks that are relevant at the IT level may have been identified, so that these necessarily have to be again identified using a more detailed analysis for IT. Please refer to Sect. 5.1.7 for more details on risk management. Risks will be mitigated in a variety of ways, and some risks which cannot be totally eliminated and are still significant need to be addressed by means of concrete actions in the service continuity plan.
- *Plan*—this is part of Planning & Design phase in which the different Services, their SLA during the Disaster are determined, and the corresponding mitigation actions identified. This should include a very detailed Disaster Recovery plan which should go all the way up to the transactional level of what steps need to be executed upon the trigger of a major disaster. The basic principle guiding it is the restoration of services within time so that it complies with the Business Continuity SLAs.
- *Business Continuity SLAs*—when disaster strikes, the regular IT SLAs normally cannot be met. As such, a different set of SLAs takes effect until final recovery from Disaster.
- *DR Site*—fires, tornadoes, typhoons, and most especially earthquakes and floods are local in nature but may affect a large area. As such, it is best practice to have the standby infrastructure in a location far from the main location of the servers, normally 30 km or more. In case of total failure of the main data center, the DR site is to enter into production.

As a plan is best when it is tested, the IT Service Continuity Plan should be executed by simulating a disaster. By executing the plan, the different steps that are to be undertaken are followed and the times to execute measured. At the end of the exercise, things that were not accounted for or that can be improved are then used to refine the plan further. This disaster simulation should be done at least once a year, and should be selected at a date and time that minimizes possible impact to production.

### 4.5.9 Information Security Management

This is a whole topic just by itself due to the very fast and changing nature of the threats to which IT systems are exposed to.

Information Security refers to policy, execution, applications and infrastructure that guarantee:

- *Confidentiality of data.* In which only personnel authorized to access such data are allowed to access it.
- *Integrity.* In which information, applications and systems remain unadulterated or altered from the original intended form.
- *Availability.* In which information, applications and systems can be used whenever needed in accordance with their design.
- *Reliability* of systems and applications, so that these perform in accordance with their design, and have not be altered or unadulterated by unauthorized personnel compromising their performance.

Information Security relies on many different components for it to be attained:

- *Policies* which determine the do's and don'ts, as well as the how to go about requesting and executing aspects which have an impact on information system security.
- *Guidelines and procedures* which determine at the working (operational) level how these policies are to be executed. While policies apply to the general populace including users and IT personnel, guidelines and procedures will be specific depending on the type of personnel, whether a user, or to which specific team in operations the guidelines will apply.
- *Configuration Items* which apply the different security settings in the assets so as to guarantee that the security aspects are addressed. Examples of these are patches, security upgrades, as well as settings in the application related to security (password lockout on the third try, for example)
- *Architecture of the network.* As there are best practices in terms of designing the network architecture so as to ensure its security.
- *Security infrastructure.* May be both at the network level, as well as on the server side. This may include security appliances (Intrusion Prevention Systems), firewalls, and the like.
- *Security software* that addresses particular security concerns, these may be at the server side, at the endpoint, or in-between at the network level as well. Includes anti-viruses software, whitelisting software, among others.
- *Code.* That is in accordance with policy and procedures, which should in turn be in accordance with global best practices in ensuring secure code.

Information Security management implies the proper application and management of all of the above (more in Chap. 10). It is not enough to just focus in one area, all these need to be in sync and continuously monitored and adjusted so as to ensure that they address the changing landscape of security threats. Forgetting one of its components can result in serious consequences. As an example, having a good network architecture, proper policies, as well as advanced security applications and appliances may not be good enough if the proper work-level implementation of security procedures is forgotten.

Although commonly thought of as just technical threats and vulnerabilities, most successful security breaches also carry some social component, such as:

- *Phishing*—in which a user voluntarily gives out personal or company information by being made to believe that the requestor is legitimate. These include emails which supposedly come from legitimate sources and request you to perform an action the user would normally not do so (such as entering his admin account and password in a false website).
- *Social Engineering* refers to psychological manipulation of people into performing actions or divulging confidential information. For example, by befriending the person and extracting the information needed during conversation or by accessing his personal laptop.
- *Physical access*—to servers, switches or other devices which normally would be physically isolated and protected from access.

Breaches in Information Security have several possible implications:

- Access and use of confidential systems and data.
  - This is especially critical in a financial, retail environment where financial information is kept. A breach may mean that the hacker can now reuse this information to conduct financial transactions using customer's details.
  - Sometimes the data may not have financial value directly, but may be used to blackmail the user or may be sold to others that may have a use for this information, including competitors.
  - Espionage and theft of intellectual property.
- Destruction of data. In which the user or company is blackmailed if he refuses to accede to certain demands, which may be monetary or of other nature. Destruction of data may also be used to undermine a company or individual.
- Disruption of operations—either by destruction, denial of a service or decreasing dramatically the reliability or response time of an application. This is commonly found in internet-facing applications which are inherently exposed.
- Destruction of machinery. This is especially true for applications used in controlling machinery. If the application is made to control the machinery in a manner that causes hazard, then it can actually destroy the machinery or the production it is handling.
- Taking over of the machine. This is when a server or endpoint is compromised so that it comes under the control of a remote, unauthorized user. This is usually the first step in using the machine for further intrusion within a company's network, or its use to launch attacks through the internet. By using a third person's machine for attacks, the originator of the attack can remain anonymous.

#### 4.5.10 Backup

Backup policy will be determined by IT in accordance with the application, as well as backup resources available for that task. Backup may be undertaken by ITOM or TM, but policy should be determined primarily by TM. Backup policy should ensure that all systems and data be regularly and properly backed-up. Take note that there

are diverse ways of backing up and that the strategy will again depend on the type of application, data, and tools available.

Aside from the regular backup, policy should dictate that a special backup be expressly requested before any major change is released, so that in case of failure, restoration to the original configuration can easily be done.

Backups should also take into account physical location of the backup media, so that if for example a disaster occurs (fire, earthquake, etc.) the media is not in the same location as the servers backed-up, so the backup media does not get destroyed, or it becomes a time-consuming endeavor to retrieve the backup media. Media may be rotated physically (by getting a copy of the tapes) or may be by means of a “hot” or “warm” replica offsite.

Backups may be incremental for a certain period of time (say a week), after which a full backup is performed. Incremental backups are much faster than full backups to execute, however, regular full backups are needed in order to ensure that the whole system can be restored to in case media becomes corrupted (in one of the incremental backups, for example).

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## 4.6 Retirement Phase

At some point in time, services may become obsolete for a variety of reasons:

- An alternative technology has replaced it
- The business process it is supposed to address is obsolete and no longer used

When such circumstances occur, then the service will be flagged for retirement. Normally, retirement of a service is discussed long before it is actually undertaken, most especially with the end-users, so that their transition to the new system is as seamless as possible. A normal procedure for retirement would be:

- Advisory to all concerned users on the retirement of the service
- Final backup of the complete application, just in case there is a need to revert, for whatever the reason
- Decommissioning of the application and related software and infrastructure components.

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## 4.7 IT Strategy

The main role of strategy is to update the service catalog with new services relevant to the business, as well as finding ways of improving the service levels and reducing the costs in delivering these services. IT Strategy provides the guidance on how to design, develop, implement and improve service management, aligning it with overall company strategy.

The overall aim of IT strategy is to ensure that IT services are strategic in nature and are aligned and contribute to the overall company direction and objectives. Mainly, the roles of IT strategy are:

- Identify the market for new IT services (for external customers)
- Design and develop these new IT services
- Guide on the service management improvement process so that it better fits and is aligned to company strategy. This includes reducing costs, having better service, and increased efficiencies. Such improvements may be significant, especially if the IT clients (whether internal or external) need to pay for these services. By making the services more cost effective, these will in turn be more attractive.
- Develop policies, guidelines and processes that will assist in the above.

Designing new services has a direct relationship with portfolio management. The portfolio manager will have a series of projects under his responsibility, which may also include O&M. Oftentimes this portfolio manager is the CIO himself, who continuously aligns the different portfolio components with the overall company strategy (see Chaps. 7 and 9). One of these portfolio components is in fact Operations itself. It is thus the duty of the Operations Head to inform the portfolio manager (i.e. CIO) of his perceived needs, so that the portfolio manager can prioritize on the different improvement actions and projects to design. At the same time, the portfolio manager must also inform the Operations Head on the company's strategy and how this needs to be operationalized.

Take a few examples:

### **Example 1: Improved collections**

During the last management committee meeting, it was determined that the accounts receivables have been bloating to unsustainable levels. Upon analysis, this was due to several factors, but one being the lack of collection agencies accredited by the company for the payment by customers of their regular bills. As such, the commercial dept. initiated a program of accrediting new agencies, and this in turn requires that IT expand its coverage to integrate these agencies, as well as reduce the collection clearing process from the current 8 to 2 h.

In this example, there is a practical and direct effect of what company strategy and direction requires from the portfolio, affecting all the way down to operations. For operations, this means having to find ways of improving the collection process in terms of performance. After some analysis, it appears that the program for posting the collections into the system is not optimized, plus a higher priority needs to be assigned to this batch process in the application server. In this case, there is a direct improvement on one of the SLA's KPIs, that of posting collections, and it was determined that the Operations team is able to address the above by opening a pair of tickets, assigning the optimization of the posting program to AM (and subsequently to a developer), and then to TM and ITOM for the prioritization of the batch process.

**Example 2: On-line collections**

Along the lines of the above issue that affects company strategy, imagine another scenario in which it was decided to come up with an app that allows for real-time, on-line payment which will now link with the back-end. It was determined by the portfolio manager that this requires a payment gateway to be setup, with all the different validations, before sending the collection information to the backend. In this case, this payment gateway needs to be developed from scratch and was launched as a new project.

As you can see from the two examples, a change in company strategy may result in a modification for Operations strategy, or in a new project, depending on the scope and nature of the solution. More of this discussed in later in this section.

For operations, IT strategy is one of the main roles of the Operations Head, as well as the Portfolio Manager handling the operations, and if the latter is not the CIO, for the CIO as well. As you can see above, it is important that the strategy at each level be aligned, because otherwise, the effort becomes useless. A service may be improved way beyond its SLA, but if not required, it does little to contribute to the company's general strategy and objectives as well as its business.

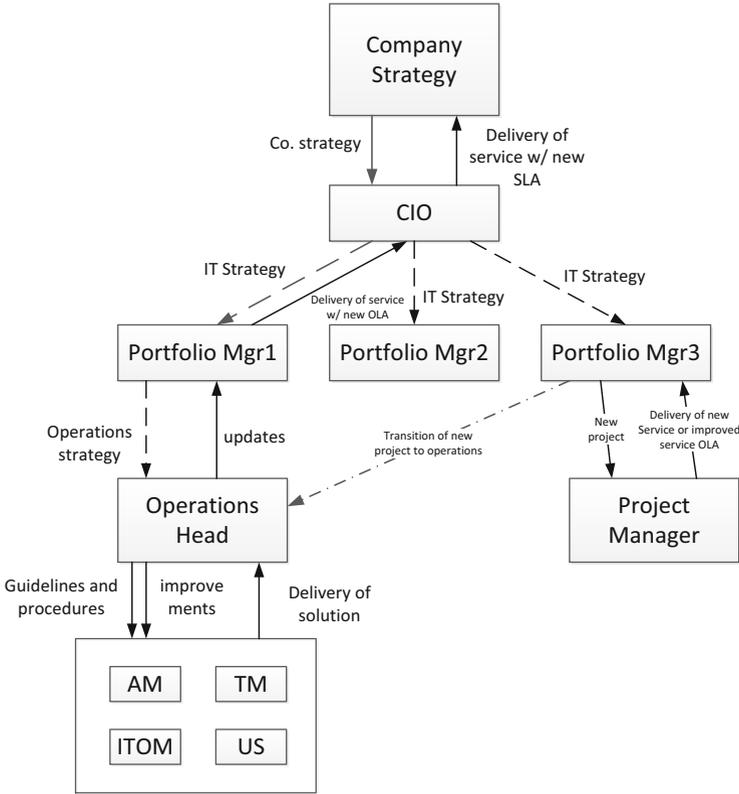
IT strategy is also linked to continuous service improvement, in that it can also set the direction and guidance for the service improvement. Along these lines, projects may also be defined for the benefit of operations. This means that projects may also be put in motion for the specific purpose of improving operations, and consequently, operations' SLA. This may altogether be different from the project defined in example 2, as the project in this example was to provide a new service altogether. Operations' projects do not usually result in a new service, but rather, the improvement of an existing service. Take the following example

**Example 3: Automated testing of collections' posting processes**

It was also identified that one of the more time-consuming aspects of integrating new collection agencies is the testing of their batch collection data and testing for the correctness of their algorithm. As such, a new project was put in motion to automate the testing of the entire posting process, and it involved the installation and set-up of a test tool, definition of the test scripts to be used, and the automation of these. The testing effort was thus reduced from an average of 3 days to just 20 min.

As you can see, the installation of the test tool and deployment for the collections' posting did not create a new service, but rather, improved on the delivery of an already existing service. It thus improved operations.

Linking it all together, Fig. 4.15 represents a typical interrelationship between projects, portfolio and Operations with company and IT strategy:



**Fig. 4.15** Relationship between IT strategy, operations and projects

What Fig. 4.15 shows is the typical process that would be involved in cascading strategy throughout the IT organization. Company strategy, usually defined in business terms, needs to be translated by the CIO into IT strategy and objectives. These are then cascaded as IT’s strategy and direction to the different portfolio managers. As portfolio managers are continuously realigning their portfolio to meet company and IT strategy, they take this into account to create one of either two:

- An updated operations strategy which will further be refined by the Operations Head into new or updated guidelines and procedures. In turn, as there may be work that needs to be done to align operations to the new strategy, a set of improvements may be identified for execution by the O&M team. Once this is finished, it results in either a new service, or most likely, an improvement over an existing service. This improvement may be internal and thus requires only an update on the OLA, or may go up all the way to an improvement in a service’s SLA. In case of the latter, this is then cascaded by the CIO as an update to the whole organization.

- A new project is identified by the portfolio manager. This new project may be:
  - An improvement for operations, thus enhancing its OLA (example 3 earlier); or
  - A totally new service (example 2)

In any case, the project is then assigned to a corresponding project manager to handle. Once the project is completed, the new service is updated into the service catalog, and the OLA and (if applicable) SLA updated, together with the transition of the service into operations (as shown by the dotted line in the figure).

In other words, new strategy may translate into additional operational improvements or changes, or into a new project which will eventually be phased into operations.

## 4.8 Continual Service Improvement

Continual Service Improvement is also referred to as the PDCA (Pyzdek 2003) cycle, which stands for:

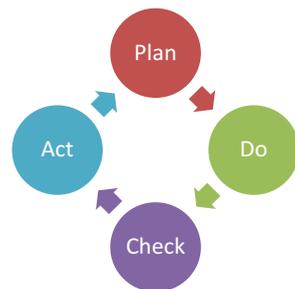
- *Plan* for the improvement
- *Do* the action
- *Check* the results
- *Act* to adjust the plan based on the results

It is referred to as a cycle because improvement is continuous and never stops, and may be represented by a diagram such that shown in Fig. 4.16.

Applied to operations, this is the process that leads to its continuous improvement. Normally, and in order to institute continuous improvement, this would have several phases, depending on the maturity of the organization:

- *Phase 1, Stabilization*: the day-to-day operations must first be stabilized. One cannot think of strategy and strategic improvements if the basics are not yet addressed. A person firefighting cannot possibly devote time to more beyond to resolving his immediate problems.

**Fig. 4.16** The PDCA cycle



- *Phase 2, Top-down driven improvements:* in which the more senior personnel (CIO or Head for Operations) identifies the areas for improvement, designs the actions and delegates his team for the execution of the improvements.
- *Phase 3, collegial body improvements:* in which every person in the operations organization proposes new ideas for possible incorporation as an improvement. This is the final objective, in that all the employees devote time to think of ways and means to improve, and work in an open ambiance in which they can suggest ideas without fear of retribution.

The reason why the last is ideal is:

- That it opens up a plethora of possible improvements because it is not just one or two people thinking of improvements but a whole team
- The best suggestions on what to do are from the people directly exposed to the work they do, because they are able to perceive of better ways of doing these.
- Using a top-down approach eventually stifles innovation and creativity because people have no room for expressing themselves as they believe the boss will always be the one to address and resolve the problem
- Ownership. In which people own the ideas, believe in what they do and execute it till the very end.

PDCA sessions when trying to achieve the most advanced stage should be formulated in such a way that there is open discussion, in which no idea is bad and should therefore not be shut down. People need to keep an open mind about ideas and not make pre-judgements. An improvement idea may contain several phases, so it is important that not only the end result is measured, but most importantly, the actions leading to the expected improvement are also measured in terms of progress. Each of these can be measured by means of indicators. Two types exist:

- *Lag indicators*—these are the *RESULTS* from applying an action. These are usually simpler to measure as they can easily be quantified. Samples are cost reduction, increase in revenues, capturing of more clients, etc.
- *Lead indicators*—these are the indicators (i.e. actions) that are really within the control of the person executing the plan, and these actions should lead to the improvements that will be seen in the lag indicators. They are generally more qualitative than lag indicators, but they must be executed for the final results to be achieved.

A good way to measure the progress of the continual service improvement mechanism is to use a scorecard. This scorecard will contain a mix of both lead and lag indicators so that they can be monitored in terms of their progress. Lead indicators need to be represented as these are really the actions within the control of the team. These need to be reported on a regular basis, until the final objective is achieved.

**Table 4.2** Example of Lag vs. Lead indicators

Lag	Lead
Optimized service rate calculation Program (calculation time reduced from 5 to 1 h)	Analysis and design
	Coding
	Testing
	Deployment



**Fig. 4.17** Sample of dashboard display items

As a general rule, indicators chosen must be:

- Specific
- Measureable
- Achievable
- Realistic
- Time-bound

Actions should be measured as they go through different phases of execution so that progress can be measured. Thus, for example, if the action consists of coming up with a new program that shall reduce the calculation time of a complex problem from 5 to 1 h, its different phases may look like that shown in Table 4.2.

As an idea is discussed by the team and accepted as the next improvement to focus on, a follow-through must be done. This means that its progress is to be monitored as it is executed until final results obtained. It is thus important that these initiatives be reported regularly, and the best way to report them is by means of visuals: graphs, displays, dashboard or color codes which shows the progress of the scorecard. Samples of these are shown in Fig. 4.17.

Simple use of colors such as red-yellow-and green show the progress in the attainment of the initiative, or alternatively these can be represented by means of a signal light, a speedometer, or other eye-catching visuals. It is best to display these visuals in a location in which all involved employees can see them, and appreciate the progress being made.

A session for discussing these initiatives needs to be conducted regularly (weekly, every 2 weeks, etc.) and the initiative presented and discussed. The initiative should be aligned towards what the company's overall direction and objective is, or if this is too abstract, then at least to IT's specific objectives and strategy. These change from time to time, so that it is the CIO's task to give direction and indicate what is the updated strategy, and what are IT's priorities. When initiatives are presented, these should be analyzed for relevance by the group, and if the decision is to pursue them, then the regular meetings should indicate the follow-through progress. These meetings are also a chance to involve different departments, especially if help and/or collaboration are needed from them, so that it can be formally requested from them. In this sense, this discussion of initiatives involves the whole group, so that accountability is not only to the direct boss, but also to one's peers.

The regular Continuous Improvement Plans meetings should be brief and concise, discussing what new initiatives have been thought of, what are the steps in executing these, and what assistance is needed from other groups. Regular meetings discussions should update on what was done in the last time period, what will be done in the next time period, as well as any issues faced, and an acknowledgement on help received from another group in resolving the issue. This meeting should not turn into an operations meeting, and needs to be focused, hence a short time allotment of 5 min will be given for each person to discuss her particular initiatives. Too long a meeting will make it boring and will make other people drift from the meeting.

Take note that an initiative may take a long time period to attain its objective because of its complexity or number of tasks involved. It is not expected that the initiative be finished in the next time period, but it is expected that it be broken up into chunks of actions of which progress can be reported regularly. This is aligned to the expectation that all actions and initiatives be measurable.

Another important aspect is that indicators be realistic and achievable. It makes absolutely no sense to target initiatives which are way beyond comprehension, capability, capacity or responsibility for one to undertake. Continual improvement means taking small but successive steps for improving the performance or efficiency of IT's services, but given time, and as a whole, they make a big impact on the overall performance. Time-bound means that whenever a target is identified, there must a commitment by when this will be attained, and should be kept as such.

Lastly, we differentiated between lead and lag indicators. As lag indicators are those which are the result of the lead, they give evident benefits to the organization because they can be measured in ways that directly impact the service level: faster by, reduced cost by, reduced manpower by, increased revenue by, improved customer satisfaction, are some of the sample measures that can be used. As these however are the result of several lead indicators, they are not directly controllable. It

TECHNICAL MANAGEMENT			
MEASURE	WIG (LAG)	LEAD	STATUS
<b>97%</b> <b>(7175/7425)</b> <b>28 for deletion</b> <b>22 waiting user</b> <b>input</b>	Update tag description for technical datawarehouse by 1st week of Feb (completeness of documentation)	List down all point sources of tags	✓
		Request from the owners to update tag description (Waiting for 2 more)	⚠
		Consolidation	⚠
		Updating	✗
<b>4/127</b>	Firmware/patch upgrade for all switches by March (reliability)	Identify switches with latest upgrades	✓
		Application of script in switches of automatic patch update	✗
		Implementation	✗
APPLICATION MANAGEMENT			
MEASURE	WIG (LAG)	LEAD	STATUS
<b>2/7 TBOM</b>	Build up of HR processes in Solution Manager by Feb2015 (faster testing)	Inventory of HCM processes (still compiling existing blueprints) 7/7 pending Training and Events Management	✓
		Build up of process structure 7/7	✓
		TBOM creation (2/7)	⚠
		Update configuration details	✗
		Update program details	✗
<b>79/79</b>	ETL (Business Intelligence) table verification by EO November (with BI) <i>*New timeline: EO 2/18/2015 (address incidence)</i>	Analysis and Documentation (79/79)	✓
		Development (3 weeks for all tables) (79/79) MCF	✓
		UAT (2 weeks; 1st week - report generation/testing. 2nd week - testing) SAP to staging extraction tables and Daily Jobs	✓
		Implementation (per report) 2/18/2015	⚠

Fig. 4.18 Sample report of improvement plan showing initiatives

is the lead indicators that are, and usually, these are the ones being reported by the line during the continuous improvement meetings. Figure 4.18 shows a sample report with initiatives.

If there is an initiative which merits a lengthy analysis and/or discussion, this can be taken up in a separate meeting with the concerned parties, so as not to unnecessarily burden the whole group discussing details not relevant to them.

Continuous improvement guarantees that the organization dynamically adapts to the changing environment scenario, including changing strategies and focus.

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*Project Management is the second most important consideration in an IT organization after running the day to day operations. Project management is quite a developed technique in other industries and the same can be applied for IT projects. One particularity stands out though, that in IT, all deliverables are mainly intangible. For this reason, scope management is of primary importance in order to properly manage an IT project, which includes full documentation in the many phases the project goes through: scope preparation, technical and functional design, blue printing, definition of business process, and later on, cut-over preparation, testing, training and managing change within the project.*

*Projects also have several dimensions: scope, time, cost and quality, and it is these factors that the Project Manager needs to handle in order for the project not to run amok. Scope and time management techniques should be used in conjunction with regular monitoring and control procedures, including regular evaluation of risks. Again fundamental to the monitoring and control are the use of standardized tools which help in such an endeavor: computer-based tools for project tracking, an issue registry, a request registry, and the use of a project checklist which clearly delineates all major deliverables of the project.*

*Essential for the learning organization is the knowledge management aspect of a project, which ensures that issues encountered during the project are properly documented and stored in a Document Management System that allows for easy search and retrieval.*

*Lastly, the most difficult aspect to be managed in a project is people, and this is where communication management and people change management come into play. This is both a science and an art that is developed and refined from experience, and we give some guidelines and examples of how they can be addressed.*

## 5.1 Project Management Principles

Much of terminology used here is based on of the PMP standard as described in the *Project Management Book of Knowledge (PMBOK)* (Project Management Institute 2013). This terminology is widely accepted in the project management field, but as it is generic across all industries, we elaborate on the specific project management methods that are used in the IT field. All of this is based on a waterfall methodology approach and discusses techniques that I used and refined after many years of experience of working in this field.

### 5.1.1 Basic Principles and Characteristics of Projects

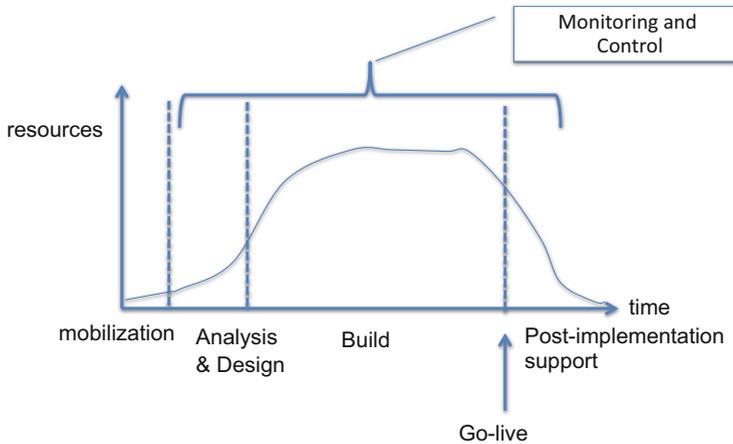
As already indicated in the introduction, projects have distinct properties as compared to operations, perhaps the most important being that projects have a very distinct start and finish, while operations are continuous in nature. As such, IT projects have distinct phases which can be described:

- Mobilization
- Analysis & Design
- Build
- Post-implementation support (which may or may not be part of O&M)
- Closure
- Monitoring and Control

Although these phases typically overlap, they can be distinctly identified as the tasks being undertaken are different for each phase. In general, these phases may be represented by a graph as shown in Fig. 5.1.

Below we explain each of these phases:

- *Mobilization*—typically this consists of the preparation activities for the project, and includes preparation and signing of contract, mobilization and readying of the resources, procurement of necessary software and hardware, preparation and on-boarding of team members, provisioning of resources, etc. This may also include a more detailed analysis of the customer’s environment, needs, and may be accompanied by some interviews so as to quickly refine the project plan and some of the ambiguities in the Scope of Work.
- *Analysis and Design*—During this phase, a detailed analysis of the user requirements is initiated with the objective of having a full and complete design signed-off by the users by the end of the phase. The idea here is that no configuration or coding work should start until concurrence from the users is received, in the form of the corresponding signed-off design documents. Installation and setting-up of the O/S, DBs, environments and applications may be part of this phase, however, only after the corresponding technical architecture document is also signed-off by the users. Among the activities undertaken in this phase are:



**Fig. 5.1** Graph showing the typical phases in an IT project

- *Project kick-off presentation*: in which a presentation is given to all those involved in the project, from both the vendor and the client organization to get concurrence and agreement. It usually contains the following:

*Table of Organization*: in which the roles and responsibilities are defined including that of the vendor's project team, involvement and role of identified counterparties from the customer organization (typically, counterpart project manager, business experts, users, etc.), as well as their concrete role in the project. This can be represented in a RACI chart, if appropriate.

*project plan*: this should be a more refined version of the project timeline and tasks that will be undertaken for the project based on interviews as well as more details obtained during the initiating phase, which allows the project manager to have a clearer grasp of the scope, current situation and environment in which the customer operates.

*Project scope*: even before the start of the project, the project scope should be clear to both parties, otherwise this may cause misunderstandings, costly change requests, and/or non-agreements which are detrimental to the project timeline and cost, not to mention the relationship between the customer and the vendor. However, there will always be grey areas which need to be further clarified, and the sooner these are clarified and an agreement is struck, the better. Remember, the later the change request comes in, the more costly overall to the project in terms of time, cost, and quality. Thus, the kick-off presentation and all related meetings should serve to tie-down any loose ends that may remain. If these cannot be totally cleared, they should be flagged as such for further, early clarification and agreement.

*Deliverables and acceptance criteria:* same as with scope, this is the right moment to make it completely clear (if not yet clear) to both parties what are the exact deliverables and acceptance criteria for the project.

*Communication plan:* when, how and who will be communicated what.

This is further explained in the communication management section of this chapter. What is important is that this be discussed and accepted by all parties at this early stage, including the end-users. It may be hard to get the end-users' presence and acceptance at any other time, so this is the moment to do so.

- *On-boarding session.* This is a session conducted between the two PMs, as well as the lead personnel from the vendor's side. It serves as a discussion of important points for the project and normally includes the following:

*Review of policies and guidelines.* The project team is updated by the customer PM on the customer's guidelines, policies and procedures to which the project must adhere to. This would include release management procedures, security guidelines, procedures for raising requests, procedures for raising change requests, among others.

*Deliverable checklist.* The deliverables should have been indicated in the TOR at the time of tendering, however, every project and every application is different, so that there also needs to be an agreement on what deliverables are applicable for the project (more of this discussed in Sect. 7.3). This will not only include documentation, but also trainings, workshops, major sessions, and other "outputs" expected from the project. A checklist is the final list of deliverables agreed by both parties.

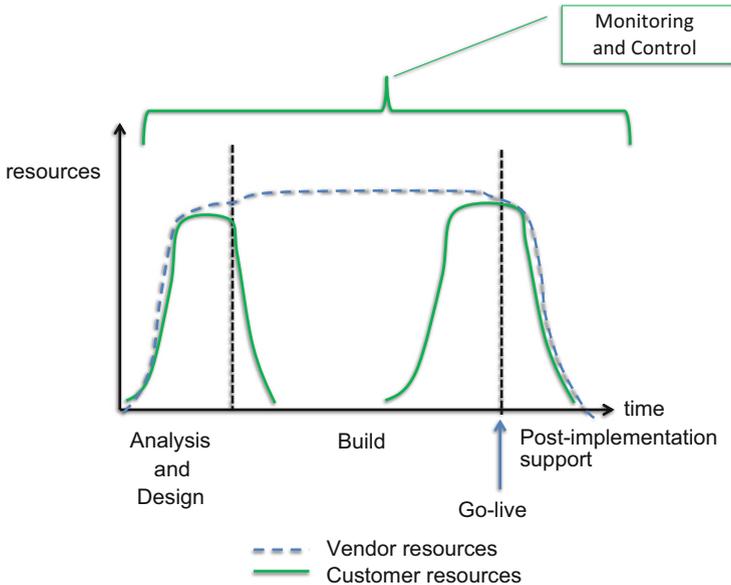
*Documentation format:* part of the discussion during agreement on the deliverables checklist is the format of the documentation to be used. Again, typically, the customer will have its own formats, but because each application has its own intricacies, adoption of vendor's format or tweaking of existing documentation may be needed.

*Authorized signatories.* This should have been discussed with the users during the kick-off; however now with the customer PM, the signatories for each deliverable will be identified. This is because aside from the users, there are documents which only IT needs to sign-off (such as technical architecture, technical documentation, code documentation), so it must be clear for each deliverable who and up to what level should these be signed-off.

*Escalation procedure.* This may have been touched briefly during the kick-off, but will now be discussed in detail. It is important that the procedure be clear from the very start so as to avoid dragging of the issues affecting both time and cost.

*Change Request procedure.* Again, may have been touched during the kick-off, but since IT is normally the party that has to shoulder any additional costs, there should be a discussion on how CRs should be raised and approved.

- *Requirement gathering meetings.* These meetings with the end-users are for the project team to gather the specific requirements from them and successively define and refine the specifications until these are finally drafted in the form of design documents. Design documents are then drafted and presented to the users for their sign-off, signifying that the project team has been able to correctly capture their requirements. This is probably the most important part of the project, as mistakes here result in loss of time and effort, so the documents used specifically in this task are explained in more detail in Sect. 5.2.
- *Design Sign-off:* Needless to say, in order to proceed with execution, all of the design documents need to be acknowledged by the different parties as being final and binding. This works both ways, it is binding to the vendor in his commitment in producing what has been signed-off, and it also means that any divergence from what has been signed off is a Change Request (CR) regardless of whether it has a cost implication or not. It is both the PMs' duty to manage and control CRs so that they do not become a cause for project creep which will cause further delays and possible cost overruns.
- *Execution (Build)*—in IT projects, execution can further be subdivided into sub-phases. these typically are (using a waterfall project management methodology):
  - *Build:* Once the analysis and design documents have been signed-off, the build phase commences, this is where the configuration of the systems, and programming (if any) is undertaken. This is the technical part, undertaken mainly by the vendor that now translates functional requirements into technical specifications which are to be put into the application. Here the customer PM takes a more relaxed mode, and will just check from time to time the progress of the build phase vs. schedule and inquire whether any issues have been encountered.
  - *Testing.* Testing is composed of many different types of testing as explained in Sect. 5.5. In its most basic form, unit testing and integration testing are first conducted by the vendor team to check everything is working correctly. After this has been confirmed, then the end-users are called for their validation, in the form of UAT (User Acceptance Test). Several UAT iterations are usually needed (2–3 typically) before the application is threshed out of errors and can proceed to go-live.
- *Go-live:* refers to the transfer of the application from the project environment (development and testing) and into production so that the users can start accessing and transacting with the system. This is the most critical in terms of impact, user's perception and acceptance of the application. Most critical here is proper cut-over, for which we have a whole chapter devoted to it, but here is a brief description:
  - *Cut-over:* refers to the activities required before, sometimes during and shortly after going-live in order to guarantee a painless transition from legacy to the new system. It includes technical and non-technical aspects, and is usually the most risky phase in a project. Examples of activities include data



**Fig. 5.2** Graph showing resource allocation per phase of a typical IT project

migration, familiarity of the users with the new process, training, manner in which old transactions in the old process will be moved to the new process (if not automatic), etc.

- *Post-implementation support*: once the project goes live, there are typically a large number of incidences, technical, functional and user-related which need to be addressed as soon as possible. During this phase, both the project team and O&M need to be on standby furnishing first and second level support (who is in charge of which support level is discussed further in Sect. 6.7). This phase is one also commonly underestimated and requires careful planning and foresight. Good testing always minimizes the need for more post-implementation support, but it can never be eliminated.
- *Monitoring and Control*: this occurs during the whole duration of the project, principally the project managers (customer and vendor side), to ensure that the project is within scope, time, cost and quality. This again requires extensive discussion, so that we have devoted an entire section to it.
- *Closure*: signifying formal project end. Formal closure is done after all reported project incidences detected under the warranty period have been resolved, all deliverables submitted and accepted, as well as training and documentation submitted.

Effort exerted by the customer side differs considerably from that of the vendor; if we were to represent the effort from both sides in a chart it would look like that shown in Fig. 5.2.

**Table 5.1** Projects vs. Operations

Projects	Operations
• Creates its own charter, organization and goals	• Semi-permanent charter, organization and goals
• Purpose of change	• Purpose of status quo
• Unique product or service	• Pre-defined and approved product or service
• Heterogeneous team	• Homogeneous teams
• Definite start-definite end	• Ongoing (continuous)
• Progressively elaborated process deliverables	• Fully-known process deliverables

What this graph shows is the typical involvement in terms of resources. As is apparent, vendor resources peak and plateau during the build phase, as all the work defined during the analysis and design are to be implemented. On the other hand, customer resources have two distinct peaks: one during the analysis, design phase and the other right before going live during the cut-over phase. The first is due to the deep involvement from the customer side, typically end-users and business experts, in defining clearly the detailed design of the system that will be built. During cut-over, the typically heavy involvement from the end-users is testing (which should be done by them), and in some instances, additional cut-over activities (please see relevant section in this chapter) that are needed for a successful go-live. Examples of the latter are data preparation, recreation of live data in the new system from the legacy system, etc.

Projects have distinct characteristics if compared to Operations as shown in Table 5.1.

One of the distinct ironies in projects is that they evolve from a less to more defined state in terms of scope definition, while at the same time, the ability for the project manager to direct the course of the project (and thus, its success) goes from high at the start of the project, to low towards the end, as the project takes its own course. This means that the project manager's ability to direct the project is in fact highest when his knowledge of the project's scope is lowest!

Uncertainty (and therefore risk) are also high at the start of the project, and tend to decrease as the project progresses due to proper monitoring and control. If properly managed, risk decreases with time, while the cost of any change increases dramatically as the project progresses. Changes are more costly as the project approaches the go-live, as any change means additional scope which needs to be reanalyzed, built and tested, and may have a high impact on the other project components.

One common mistake made by organizations in their IT structure is to mix resources from operations to handle projects. Though in principle it would seem to be logical (make a person handling the operations of a particular application handle projects which have a direct relevance to that of the application she is handling), it is in fact one common reason why projects are dysfunctional. Project management is a distinct methodology from operations management, and as such, a special team should be trained to become acquainted with them and have the discipline in applying and executing these. If IT personnel are to handle both, then there will be

confusion as to what to prioritize, and even what methodology should be followed. Is the ticket an operations ticket? Request for a project? If there is a conflict, which should be prioritized? How do I assign my personnel? Who should handle the operations incidence tickets and who to work on the long-term fix that the project addresses? It is just but to be expected that urgency (short-term) will always be prioritized over long-term, and that usually means that incidence tickets will absorb the team's time, to the detriment of the project.

In the next sections we take a look at all the different important dimensions and aspects in IT project management, many of these dimensions were patterned after the terminology used in PMP (Project Management Institute 2013), which is a very good standard for project management, though in this chapter we focus to project management dimensions which are specific to IT Projects and how these need to be handled (unlike in PMP which is generic for all fields).

### 5.1.2 Scope Management

Perhaps one of the most important features of IT projects is that the scope is not 100% clear during the project start. This is especially more true for IT software projects because they in fact have a lot of intangibles (software process is in itself, an intangible). This means that scope is in fact successively defined during the progress of the project. This poses some distinct dangers and risks, first and foremost, since scope is not completely clear during the project start, it may lead to assumptions which may not be true or acceptable to the customer, there may be a mismatch between what the software can actually do and what the customer desires, and further down the project implementation, this ambiguity in the scope may lead to a protracted argument and discussion as to whether a particular scope is part or not of the project in the first place.

As a general rule, the more detailed the scope at the start of the project, the better. Incomplete, incorrect scope is perhaps the single biggest cause for project failure, as there is no alignment between vendor, customer, business users and sometimes top management, in terms of what should actually be the outcome of the project. In order to address this, several techniques can be used:

- *Have a clear-cut understanding of what the project is to deliver.* Needless to say, this takes time to develop, as it may need the vendor's IT organization to interview the business users as to what they need. Many times, the business users have a hazy idea of what they want, so it requires a major effort to translate these into writable specifications that can be attached to the terms-of-reference. Ideally, the requirements shall appear in a clear, objective, written list of requirements which vendors shall have to answer comply/non-comply, and which shall be contractually binding.
- *Research and vendor presentations.* As stated above, requirements gathering is an iterative process. It thus requires a lot of work before the actual tendering takes place. Research via internet, reviews and publications from research companies,

as well as vendor presentations to both IT and the business organization are of great help in further developing these specifications.

- *Gap analysis.* Helps in defining current state vs. to-be state as desired by the business organization. Gap analyses may be conducted in-house or contracted to a specialist consulting company.
- *Contracting of design specifications.* With this approach, the analysis and design phase is contracted separately from the main “build” part of the project. This has its advantages and also disadvantages, and may not always be applicable. Advantages are:
  - *No ambiguity.* As the detailed design specifications shall be the main output, the build phase need only to comply with a very detailed scope-of-work.
  - *Cost.* Once the detailed design is out, this may be used in tendering the build phase separately. As less assumptions are to be made, and less risk (which means less cost buffers) are to be covered for by the bidders, this should typically result in a more competitive price.

Disadvantages however include:

- *Disconnect with the software.* If the analysis and design has been contracted out without specifying the software that will eventually be used in implementing the project, there is a major risk that the design becomes too theoretical, and may not be supported by the software.
- *Capabilities of the consulting firm.* As analysis and design without actual implementation carries little risk from the vendor’s viewpoint (unless of course the customer organization already has a deep understanding of the processes being designed, as well as the software product being implemented), the vendor may not put its best resources in this endeavor, may not exert all the necessary effort, or may not even have the necessary skills to actually conduct the work on hand. There is very little risk of exposure because their contract would end before actual realization of the project, so there is no good way of checking if their design is accurate and of quality.
- *Involvement during the build phase.* As stated earlier, if the consulting firm involved in the design is not involved in the actual build, the customer actually may be getting a very poor design. One way to overcome this is to let the organization that designed it bid and participate as well during the build phase. This may or may not be acceptable, depending on the procurement policy of the customer organization. If allowed, it also follows that the vendor that formulated the design is in fact in the best position to conduct the build phase, as they have the most complete information on the situation of the customer, need to make less assumptions, and would already have a very clear idea as to how much effort the build phase would entail. Again, this may or may not be acceptable to the customer organization.

As mentioned during the introduction, as a project progresses:

- Uncertainties decrease.
- Scope certainty increases.
- Cost of any change increases.
- Stakeholder influence decrease.

In summary, the dilemma may be summarized as “As the project progresses, scope becomes clearer and there are less uncertainties, but the ability to influence its direction decreases, and any wanted change in the project increases dramatically in overall cost”. As the ability to influence and direct the project is greater during the beginning of the project, and it is also during this time that risks are highest and cost in changes in scope are lowest, it is best to devote the most time to properly define scope at the beginning of the project. This may seem obvious but is shortcut many times in the interest of expediting the project, which actually produces the opposite effect. Any man-day (and \$) invested in the beginning of the project ultimately means savings in man-days and costs further down the project timeline.

During the analysis and design phases, previously agreed-upon design documents should be used to capture these. Discussion on analysis and design documentation is discussed further in Sect. 5.2.

During the course of the project, milestones which properly narrow-down and detail the scope should be signed-off before the next related task is initiated. This is especially true for analysis documents that lead to design, and design documents which lead to build tasks, test design documents before user acceptance testing, and so forth. It is a waste of time to progress to the next dependent tasks if acceptance has not taken place for the documents which specify *HOW* these tasks are to be undertaken.

Risks to project scope are many and varied, and they may come from many different sources. Some common ones include:

- End-user changing his/her mind
- A senior executive having different ideas on what should be done
- Project creep—in which small incremental changes are accepted due to the small nature of the change, however, due to the many small changes, these add up to become a significant change.
- Person approving is not the right person to approve (or does not understand the actual needs)—a key user which may be approving design documents and deliverables turns out to be the incorrect person due to many possible factors including his role being wrongly assumed by the customer’s PM, inability to understand what is being discussed, or even having no credibility with the rest of the users (even though he/she may possess the formal title)
- Unruly behavior by the end-users—includes non-standardization of processes, such that obtaining approval to standardize design and process across the business organization becomes difficult or is iteratively changed by the users.
- Supplier starts development work without getting a sign-off from the users

From the above list, it is clear that the only person capable of identifying and managing these risks and the overall scope is in fact the project manager, highlighting once more his important role.

Take an example of an executive changing his mind causing the project to delay. During the discussion on the procurement process to be implemented in an ERP, it was decided that Purchase Requests (PR) once created by the different authorized division heads, would immediately proceed to procurement for processing and eventual release of the Purchase Order, this was presented and agreed at in the steering committee meetings. At a later phase however and well into the development stage, a key executive in the organization decided that an additional approval was needed even at the PR level before proceeding to procurement, so that the development had to be redone and retested altogether.

### 5.1.3 Procurement Management and Contracting

The procurement and contracting of IT projects is quite different from that of other goods and services for the same reason as that of scope management: IT almost always deals with intangibles, and even when there are tangible assets involved, the intangible component (firmware, software, configurations) is just as important as the main asset itself.

What this really means in practical terms is that there must be a considerable effort to define and pin-down requirements before tendering. Failure to do so will result in grey areas open to interpretation from both the customer and the contractor's side. The most important document here being the Terms-of-Reference (TOR) which is the main document used in requesting for proposals from the vendor, regardless if the tendering procedure is an open bid, price quotation only, or any other form. The TOR must be written in clear and concise wording, specifying what is required from the vendor, and asking that they comply with them, or if unable to comply, to indicate the approach they will take in addressing the requirement.

An example of a TOR is presented in Appendix A: Sample Terms of Reference (TOR). The best TORs are those in which the vendor is to answer "yes" or "no" in terms of their ability to comply with the requirement, leaving no room for ambiguity. As such, aside from the main TOR body which explains the requirements and explains the background of the project, it is recommended that it be accompanied with a tabular list of requirements, a sample of which is also shown in Appendix A: Sample Terms of Reference (TOR). This list shall generally contain the following main sections:

- *Functional specifications*: which describe the functions the solution provided by the vendor must adhere to. This shall be answered by the vendor with a simple "yes", "no" or "work-around provided" to the table which asks whether they comply or not to the requirement. Under remarks, they are to fill this up with details on how they address the requirement, and if addressed by a work-around, how the work-around will address it. Optionally, the customer may opt to indicate

in a column the importance of the requirement with a Mandatory/Optional indication or if one wishes, High/Medium/Low categorization.

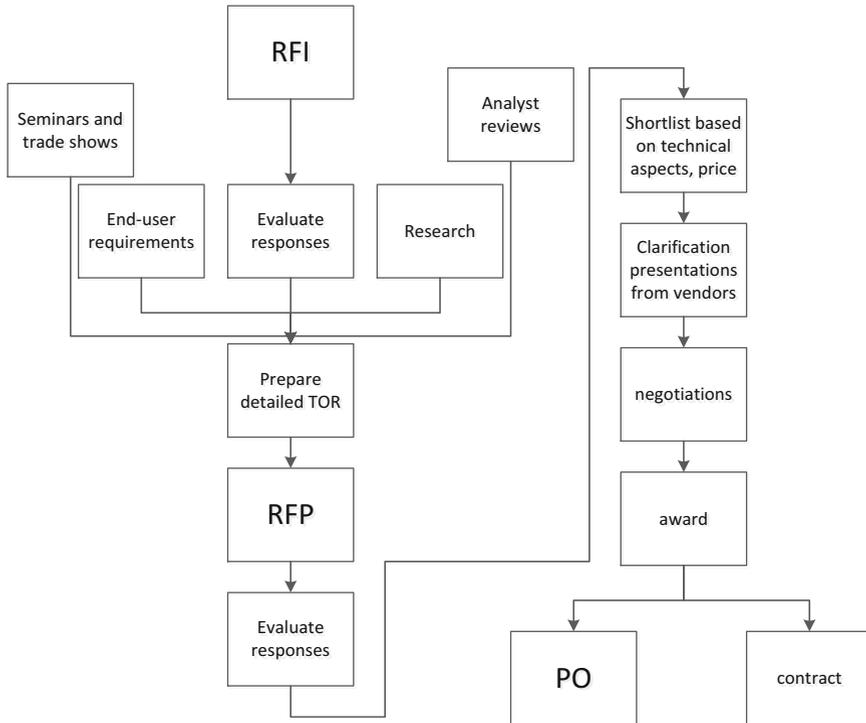
- *Technical specifications*: describing the technical requirements for the solution. This would usually include technical specifications for standard software and hardware currently being used by the customer, which you would like that the vendor adhere to, typically:
  - O/S and its version
  - DB and its version
  - Preferred programming language
  - Virtualization software and version
  - Servers
  - Use of LDAP or Active Directory
  - Network Switch brands and acceptable models
  - Required environments (DEV, QA, PROD) and their recommended server sizes (RAM, CPUs, disk)
  - Warranty period required for the hardware
  - Software license support period required for the software

Filling-up of the technical requirements shall be the same as that of the functional requirements.

- *Other requirements*: usually pertaining to particular training, testing or other aspects the vendor should take into account.
- *Curriculum vitae*: one commonly forgotten aspect is that services are the make or break for a successful project, the hardware and software components being only half the story. Thus, one may require a minimum compliance on the resources being assigned to the project, or if left open, vendor should include the CVs of key personnel with enough details for the customer to evaluate their adequacy.

It is also worth noting how different IT items affect tendering:

- *Procurement of commodity items*: includes laptops, PCs, printers, servers, memory, Microsoft licenses, etc. In this case the TOR indicates the desired specifications and the vendor replies whether he can comply. Award goes to the lowest complying bidder.
- *Tendering for a new hardware or application project*: in this case, the specifications for the required hardware and software are indicated in the TOR, however, due to the nature of the project, this is not just equipment delivery, as these components require a significant services component in order to be set up for the hardware and/or software to deliver the desired functionalities, working condition. In such cases, both the product and the services should be evaluated for compliance.
- *Consulting services tender*: in this scenario either the software application licenses have already been procured, are procured in a separate tender, or are not necessary. Desired here from the vendor are just pure services to implement a particular configuration or provide advisory services. In this case, the customer specifies exactly what he wants and the vendors must comply with the scope.



**Fig. 5.3** Typical tendering process

Only CVs, methodology and references are then evaluated in this scenario. The vendor may have a chance to propose an alternative approach to the vendor, but it is at the customer's discretion to accept such an alternative.

As mentioned before, good TORs take time and effort to build, and oftentimes the customer may not be fully aware of what is in the market, nor what exactly the end-users want. Similarly, the end-users may not really know how current technology can address some of their needs and they look up to IT for guidance. One way to build an effective TOR is by means of a Request For Information (RFI), as well as through research as shown in Fig. 5.3.

In the above flowchart, a Request for Information is used to get non-binding proposals from vendors given some very generic requirements. This can be followed-up by presentations from these vendors. Other sources of information are the internet, research, analyst reviews, as well as by means of attending seminars, workshops and presentations on the topic. Of course, essential to all of this are the end-user requirements, which need to be captured by IT and put into a document. An RFI may help the users if followed up by presentations from the vendors in which the users are part of the audience. This gives them insight and ideas on possible functionalities and approaches to their desired goal.

If the requirements can be interpreted directly by IT from the users and complemented by research, then the RFI may be omitted to save time and the TOR drafted directly. The TOR may then be validated with the users for concurrence before tendering.

Once tendered (Request for Proposal: RFP), the vendors are given a chance to submit their technical and commercial proposal, by answering to the TOR requirements. It is typical for vendors to stretch the truth in answering to the TOR requirements and be tempted to answer “comply” to all. In order to avoid this situation, a best practice is to make this proposal and answers to the TOR contractually binding, by including them as part of the contract. Non-adherence to their proposal can then be cause for cancellation of the contract, as well as application of penalties.

Evaluation of proposals can take many different forms, depending on the procurement policy of the company; however, one commonality is that any vendor considered for award must pass at least the minimum technical requirements specified in the TOR before any commercial consideration. Commercial terms must never be discussed by IT without procurement’s presence, and it is always the last aspect to be discussed with any vendor.

First and foremost, IT has to select the vendors that meet the technical criteria, and to do this, it will usually seek clarification from the vendors or ask for presentations from them. Two approaches exist:

- *Start from the lowest priced bidder.* Ask for clarifications and presentations to ensure that his proposal meets the technical specifications and all aspects are clear and covered. If he results to a complying bid, then proceed with negotiations (with procurement) leading to award.
- *Shortlist all those technically complying bidders.* Request for clarifications from all bidders to ensure that they really do meet the specifications before they are shortlisted. Once shortlisted, open the commercial proposal and start negotiations with the lowest complying bidder.

In both cases above, if there is no agreement during negotiations, be that due to some technical aspect which they do not want to agree to, the terms and conditions of the contract, or due to commercial reasons, then one must then proceed with the next lowest complying bidder, and so forth, until award is attained.

The advantage of the first method is that it is much faster; you only ask for clarifications from the lowest priced bidder and move up. Its disadvantage is that there is always some room for favoritism from IT personnel, as they can already clearly see the pricing. It is however recommended for complex projects where lots of clarifications are essential before award due to the nature and complexity of the project.

Negotiations should always be led by procurement; IT will then support it with technical information and validation in the negotiations, in order to make these much more effective. As an example, supposing that a certain level of discount is being pressed for by procurement, and upon inspection, IT saw that the vendor was

proposing 24×7 warranty support for the whole project when only 8×5 support is in fact necessary, the customer then used this fact to seek further price reduction by having the vendor commit to a much less stricter support framework. Such discounts would have not been detected if procurement acted alone without IT's involvement.

It must again be emphasized that commercial (price) negotiations should always be left for last, it is important to be totally satisfied with the technical proposal being offered before talking of price or any discounts. If during the course of clarifications IT detects points which may be used as a leverage for price negotiations (such as in the example above), then these are noted and then brought out during the price negotiations, but not before.

Concurrence and agreement during price negotiations leads to the award. It is important that all points raised during the presentations and technical clarification meetings not be forgotten. As such, these minutes of meeting should also be binding and made part of the contract, and should supersede the vendor's original proposal in case of conflict. With these, the vendor cannot escape with empty promises in which he fails to deliver later on.

Lastly, it is important to note when to use a standard Purchase Order (PO) and when to use a full contract in awarding to a vendor. Purchase Orders are contractually binding documents which place an order to a vendor. They carry a standard, albeit simple set of Terms and Conditions, usually the expected time of delivery of the goods, payment terms, general corporate quality guidelines, and the like. They are appropriate for the procurement of equipment and software which require minimal services component, as the delivery of the goods in good state are enough for payment to be released. For projects which have a significant service component, the terms and conditions of a contract are very important, and thus, these would always require a contract to be signed by both counterparties (and not just a PO).

Two general types of services and project contracts exist:

- *Turn-key projects.* In which the total project is of a fixed amount and vendor gets paid a % of the total whenever a specific milestone is attained; and
- *Time and Material (T&M) contracts.* In which the vendor proposes hourly or daily rates for different type of resources to be assigned to the client, and gets paid according to the number of days work they perform for the client. Additional expenses may also be reimbursed from the client such as airfares, hotel, taxis, per-diem, etc.

As is apparent, T&M contracts are much more risky for the client than turn-key, so that turn-key projects should be preferred by the client. Of course, turn-key projects necessitate a very detailed level of scope so that vendors can cost their proposals effectively. T&M contracts are appropriate only when:

- *The scope is too difficult or impossible to define exactly.* Take for example a problematic system which produces downtime, the customer has no clue whatsoever as to what is the underlying problem and decides to hire an external expert

organization to help it troubleshoot, it is therefore impossible to know beforehand if the work entails a few days or several weeks.

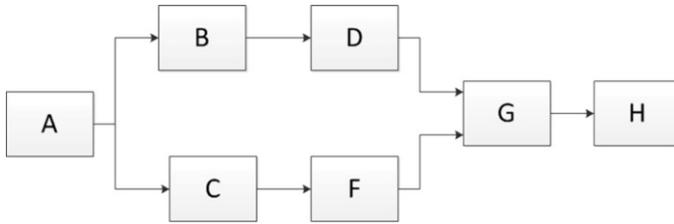
- *Consulting projects* in which it is difficult to know beforehand how much work will actually be devoted to the endeavor.
- *Support contracts which will be based on the actual number of work hours or days utilized.* It may be that actual support days may be zero or little, so it is also in the customer's interest to use a T&M contract.

Of course, in order for the billing not to bloat without limit, it may be wise to place a cap on the amount approved for the T&M and/or place checks and balances such that any work that is to be performed by the vendor must be estimated in man-days and pre-approved by the customer PM before proceeding.

Sometimes in the desire to limit risk, the opposite is sometimes achieved. Take as an example a particular government owned corporation wherein all major projects would have to be tendered and the lowest priced complying bidder awarded, including that for consulting services. In this particular case, this organization was to implement its first ERP system, and following government procurement rules, required that the consulting for the design of the ERP would come first before the procurement and setup of the ERP itself. This meant that the consulting design would have to be made generic, without actually knowing what product would actually be implemented. The award and work proceeded for the consulting work, was finished and became the blueprint specifications for the ERP. The result was disastrous as the design did not take into account particularities of the ERP application itself, so much so that certain designs were not implementable off-the-shelf and required extensive customization, and led to a protracted fight between the customer and implementer as to the manner in proceeding with the implementation.

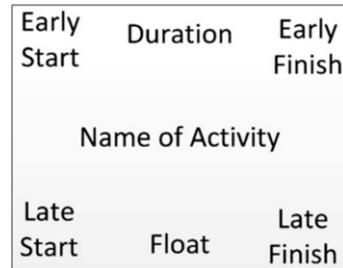
#### 5.1.4 Time Management

Project time management can be undertaken in many ways, however, due to the availability of many project management software, these can now be used, making it much more effortless than doing this with excel sheets or the like. These softwares allow interdependencies between tasks to be defined, and adjust automatically in accordance with precedence and interrelationship rules, which would otherwise need to be handled manually. A very useful technique for drawing project dependencies is the use of the Precedence Diagramming Method (PDM) (Fondahl 1987), which can be entered into these softwares, or reproduced from a Gantt chart, which is usually easier to enter. Many of the other measures we will discuss in the succeeding sections can also be automatically handled and calculated by PM software. It is however very useful to have at least a basic understanding of the theory behind the use of PDMs, so we shall be discussing this thoroughly in this section.



**Fig. 5.4** PDM diagram

**Fig. 5.5** Components of a node in a PDM



A PDM is a graphical representation of project tasks wherein:

- Activities are represented by a Node in the form of a *RECTANGLE*
- Dependency is represented by an *ARROW*

In the example shown in Fig. 5.4, tasks A to H are represented by their corresponding nodes.

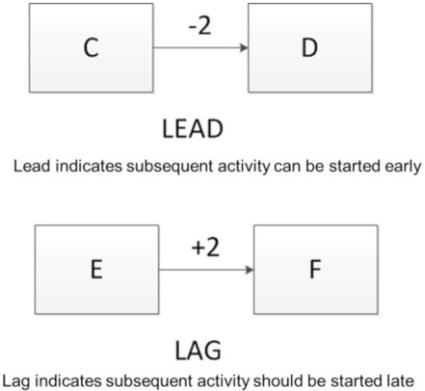
As is evidenced by the arrows, task H is dependent on task G finishing first, which in turn depends on both tasks D and F finishing. While task D depends on task B finishing, and task F depends on task C. Both tasks B and C depend on task A. By means of this diagram, one can easily appreciate dependencies between tasks.

In order to appreciate the power of PDM further, we first need to understand some more concepts. Firstly, we can represent inside each node the amount of time it takes for that particular task to be executed. This shall be represented by a number in the duration side of the node’s box (upper middle portion) as shown in Fig. 5.5.

The duration is expressed in number of standard time units, in accordance with that used for the project (hours, days, weeks...). The other numbers will be explained in a short while.

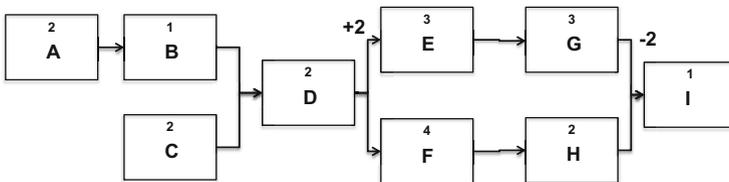
In some cases, though a task is dependent on a previous one, it may not be necessary for the previous task to finish completely before starting the new task, as it may in fact start a bit earlier. Or it may be the opposite; a previous task needs a certain “rest” period before the next dependent task is started. In order to account for such cases, a number is added on top of the arrow with a (–) minus sign if it is a lead precedence meaning it can start early by the number of units expressed above the arrow, or if a (+) positive sign is used, then it is a lag precedence, which means the

**Fig. 5.6** Lead and Lag delays between activities



**Table 5.2** Sample Activities with their duration and preceding activity

Activity	Duration (days)	Precedent activities
A	2	–
B	1	A
C	2	–
D	2	B, C
E	3	D with 2 days lag
F	4	D
G	3	E
H	2	F
I	1	H, G with 2 days lead



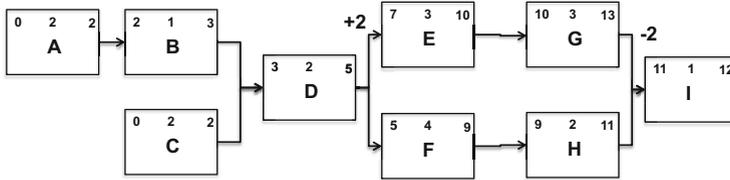
**Fig. 5.7** Resulting PDM from the example in Table 5.2

dependent task can only start after the previous task has ended, plus an additional such time units. Take Fig. 5.6 as an example, in the diagram task D can start 2 time units even before task C has ended, while for task F, it must wait 2 time units after task E has ended before starting.

Let us now take an example and build the PDM, given the tasks and precedence defined in Table 5.2.

The resulting PDM would look like that of Fig. 5.7.

We now conduct a series of calculations:



**Fig. 5.8** PDM with forward pass applied

- *Forward Pass*—Starting at the beginning (left) of the network develop early start and early finish dates for each task, progressing to end (right-most box) of the network
- *Early Start Date (upper left number)*—Earliest possible point in time an activity can start, based on the network logic and any scheduled constraint. In other words, for each activity, determine if it has a predecessor, if none, the early start date is 0. If it has a predecessor, then get the preceding activity's early finish and add the lag/lead that is in the path, to determine the early start date. If the activity has several predecessors, then do the calculation for each path, the early start date then will be the greater (latest) among all those calculated along different paths (as all preceding activities must finish before it can start).
- *Early Finish (upper right number)*—Earliest possible time an activity can finish, which is calculated by adding the early start date to the duration of the activity

For the sample example, and applying the forward pass then Fig. 5.8 will result.

A similar calculation is then made but in the opposite direction, starting from the rightmost activity towards the left, this is called the backward pass:

- *Backward Pass*: Calculate late start and late finish dates starting at project completion, using finish times and working backwards
- *Late Finish (Lower Right number)*: Latest point in time a task may be completed without delaying that activity's successor. In this case, and starting from the rightmost node, we annotate the late finish in the lower right hand side of the activity node. If the activity has no succeeding one, then its late finish is equal to its early finish. If it does have a succeeding activity, then its late finish will be equal to the succeeding activity's late start plus the lag/lead delay in the path. Take note that this time the sign of the lead/lag is inverted with respect to the forward pass' calculation, such that if there is a lag delay (+ in sign), we subtract to obtain the late finish, but if the relationship between activities has a lead delay (− in sign), then we add to the late start of the succeeding activity to obtain the late finish. Once more, if there are several activities that are succeeding it, we then calculate the possible late finish using all different paths, but select that which is smallest (earliest).
- *Late Start Date (lower left number)*: refers to the latest point in time that an activity may begin without delaying that activity's successor. This is calculated by subtracting within an activity the activity's duration from its late finish.

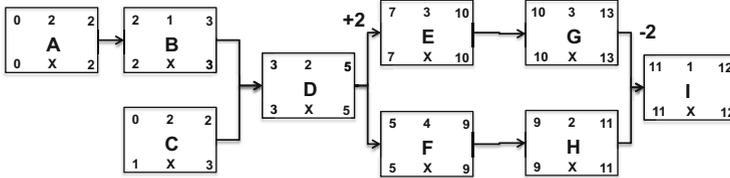


Fig. 5.9 PDM Example with backward pass applied

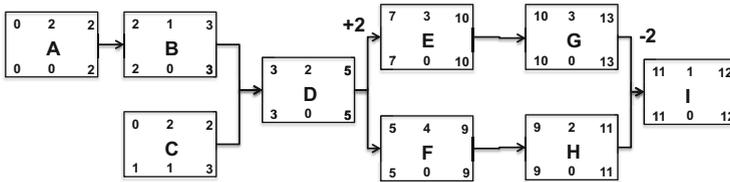


Fig. 5.10 PDM Example with float calculated

If we apply the backward pass to our example, this results in that of Fig. 5.9. Lastly, we can calculate the float (Martino 1968) (lower middle number) by:

$$\text{Float} = \text{Late Start} - \text{Early Start}$$

For each activity, and annotating these where there are X's in the boxes above. The resulting diagram is then shown in Fig. 5.10.

Float gives a lot of interesting information about the project activities. Firstly, it is defined as the amount of time a task may be delayed from its earliest start date without delaying the project finish date. Any activity which has a non-zero float has a certain “slack”, which may be used in the project as will be discussed later on. In the example above, only task C has a non-zero float, of 1 week. This means that instead of starting task C on week 0, we may actually opt to delay it for a week and start on week 1, and it will still not cause any delay on the overall project timeline. How can this be used for practical purposes? Well, if for example, task C demands the use of a resource which cannot be easily obtained from the very start of the project, his involvement can be delayed by 1 week without causing any negative impact. Many other possibilities can be evaluated for different project situations and resource situations. In cases where slack is significant and there is a commonality of resources, resources that are in activities with slack can be assigned to do other activities first instead of those with slack, as a delay in these activities need not affect the overall project timeline.

This brings us to the concept of critical path (Weaver 2014). Critical path are those activities which when delayed, will cause a delay to the whole project timeline. Activities in the critical path are those with 0 float, and so, these are the activities

which should be given more attention by the PM due to their (pardon the redundancy) criticality. To define it formally:

Critical path is the successive list of activities (path) which affect the overall finish date of the project if any of those activities delay.

In our PDM earlier, the critical paths are both A-B-D-E-G-I, and A-B-D-F-H-I. From the point of view of risk management, it makes more sense usually to devote resources to critical path activities (vs. other activities), as these will have more impact overall.

Some other important terminology to take into account is:

- *Duration*: Number of work periods, *excluding* holidays or other nonworking periods, required to complete the activity, expressed as workdays or workweeks
- *Elapsed time*: Number of work periods, *including* holidays or non-working periods required to complete the activity, expressed as workdays or workweeks

Again, one of the big advantages of using a software project management tool is that Early Start, Early Finish, Late Start, Late Finish, slack and even the critical path are all automatically determined. This automates the mechanical and redundant work, and lets the PM concentrate on more analytical tasks. Furthermore, any changes in the project baseline will automatically adjust all activities and calculations.

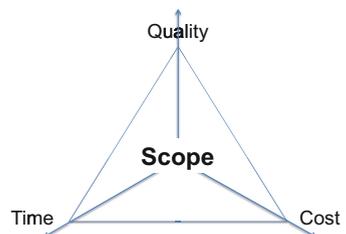
There are many more functionalities in these Project Management tools which are of great use to the PM, however, we shall restrict ourselves to the basics, and let each reader explore these by herself.

### 5.1.5 Time-Cost-Quality Management

For a defined project scope, there are three dimensions that are at the PM's disposal as shown in Fig. 5.11.

What this means is that for any defined scope, there is a fixed time-quality-cost relationship which cannot be broken given a fixed amount of assets and resources. The PM may increase or decrease any of these dimensions, but if the scope is to remain constant, this will in turn affect at least one, maybe two of the other dimensions.

**Fig. 5.11** Scope and the time, quality and cost dimensions



If delivery time for the project is to be reduced, for example, then either the quality suffers as a consequence of maintaining the same cost, or more cost (resources usually) are to be added in order for quality not to suffer. The same is true for quality, if it is to be increased, then either the time to deliver is extended or more cost is to be put into the project. Of all three, time is usually the most inflexible and hardest to control. Putting in more time into the project usually also affects cost, due to the prolongation of resources' stay into the project and may not necessarily result in an increase in quality.

All three dimensions however, should be monitored and controlled by the PM, as otherwise these may get out of control, or worse, fail the project.

### 5.1.6 Monitoring and Control

It is often said that the Project Manager is the person in the project that does nothing, and yet, if there was a single person most influential to the outcome and success of the project, it is the PM. This seems ironic, and yet it is true. The PM “does nothing” in the sense that he/she does not actually execute any of the concrete tasks defined in the project plan, these are all specialized team members that undertake them. The role of the project manager is to coordinate, make sure the tasks as being undertaken correctly, resolve if there are issues, monitor using the appropriate tools, and control the scope, quality, time, resources and cost assigned to the project. To some extent, he also has the ability to propose, design and utilize the appropriate tools needed for proper monitoring and control of the project.

It is essential that proper tools be used for the monitoring and control of the project. The proper use of these tools will lessen the dependency on the project on individual initiatives and personality of the project manager, and instead leverage on best practices. Poor tools and governance result in poor results. These tools are also not static, but should be improved iteratively as more projects are handled, more experience gathered, and more knowledge acquired. Usually, this is the responsibility of the Portfolio Manager that conducts review and improvements on project governance, together with his project managers (see Chap. 9).

In concept, the principles of IT project monitoring and control is simple; they are to monitor the most fundamental dimensions of a project:

- Cost
- Resources—these also have an impact on cost
- Time
- Scope—to ensure adherence
- Quality

Of all, the most difficult to measure is quality due to its intangible nature, followed by scope, all others can be quantified. Quality and scope are the usual point of dispute between the customer and the vendor, and the biggest reason why a project is not accepted and delayed, affecting in turn the other project dimensions.

Let us discuss each dimension separately, starting with scope. As discussed earlier in scope management, scope is usually the single biggest source of project failure. It is also a common point of contention, and is very much related to quality. Scope is a joint responsibility of both parties, customer and vendor, as a poor scope definition during the project tender is very hard to resolve once the project has started, and as a change in scope has a direct effect on the other dimensions, and most especially, cost, which is the biggest concern for the vendor. There is always a trade-off in the amount of detail that the scope should carry during the tendering process. Too much, and it will take time to prepare the tender; Too little, and it leaves room for ambiguity and discord. In any case, from a project manager's point of view, the more detail, the better. For the Project Manager, the ideal scope is that which can be enumerated in the form of a table and checked for during the monitoring and control process. This leaves little room for ambiguity.

Milestones defined throughout the project lifecycle are a tool for the PM to check the effective status and progress of a project. Concretely, they show how the project scope has progressed up to that point in time. It is recommended to have deliverable milestones defined throughout the project timeline, and not only milestones which flag payment. Milestones are the "yes/no" signal on whether the project has progressed to that point, and in order for them to be effective, some guidelines need to be followed. Milestones should be

- *Non-ambiguous* Project progress needs to be objective, in order for it to be so, a milestone must signal completion/non-completion. Avoid partially completed milestones as it again, makes it open to interpretation. Good examples of milestones are:
  - Deliverable of XXX document
  - Acceptance of XXX document
  - Installation of software
  - Acceptance of blueprint design
  - Completion of training
  - Completion of workshop
  - Submission of first wave draft reports
- *Easily checked* by both parties. Again, this is to minimize misinterpretations, ambiguity and "sugar-coating"
- *Spread* out throughout the project. So that the PMs can effectively monitor the project, if there is a lag of several months between milestones, monitoring between those months is a guess at best.
- *Practical*. The best milestones are those that are actually needed for the project as part of its deliverables, and not made just for the purpose of monitoring and control, as it may be a considerable effort just to prepare that milestone deliverable.

Time utilized for the project is of course monitored by annotating the current time, and where the project is at now. This gives you the % completion of the project. Unfortunately, this measure when used by itself has several flaws. For one, if not

used in conjunction with proper milestones, it gives you an untrue picture of where the project is really at. How many of us have encountered projects that seem to be on time, and reported as so, only to find that the last 10% of the project takes double the time as the rest of the project. Not only is this a ruinous project, but the PM may have no clue on why this has actually happened. Take another example in which the “build” part of the project (which is also the hardest to monitor) reports progressive achievements, and yet fails miserably during the testing portion of the project. This of course is related to the quality of the monitoring, which we will discuss later, but it also shows the importance of building-in non-ambiguous milestones throughout the project lifecycle.

The second big reason on why % completeness is a bad measure is that it tells you nothing on how advanced or delayed the project is with respect to the baseline. The project may be 50% complete to date, but it should actually have been 70% complete by this time, and that is not captured by this indicator alone. If the project is run on a time and materials basis (and not turn-key) then the cost overruns (savings) vs. the cost baseline are also not apparent. It is for this reason that two complementary indicators taken from Earned Value standards (Devaux 2014) may also be used, at the very least:

- SPI (Scheduled Performance Index) which gives you an indication of how the project is faring in terms of time vs. baseline project time duration; and
- CPI (Cost Performance Index) which gives you a similar measure but in terms of cost.

In order for these indicators to be well understood, however, some basic theory needs to be explained first, including the concept of Earned Value.

Earned Value (D.H. Stamatis 1997; US Department of Energy 2008) refers to the value of the work done up to a particular moment in time. This is different from cost. Earned Value reflects how the customer values that amount of work in terms of its value to him as an intangible, and not how much it has actually cost him in terms of paying the vendor for it, which is totally different. Take for example a construction project in which a four story building is to be constructed for a total amount of US\$40 million, or to simplify the example, a fully proportional, US\$10 million per floor, to be built in 8 months, or 2 months per floor as per project plan (baseline). Suppose also (even if not a very good project management practice!) that the building is being built using time and materials costing, as invoiced regularly by the vendor. From the point of view of the customer, the number of floors actually finished reflects the value of the project to him, which is different from how much he has actually paid the vendor so far. Thus, take into account the following example:

4 months into the project, you have paid the vendor US\$30 million but only one floor has been completed by the contractor.

The Actual Cost (AC) of the project is thus US\$30 million, corresponding to what was paid, however, the Earned Value (EV) of the project is only US\$10 million. The planned value (PV) at month 4 is actually US\$20 million, meaning, by this time, two floors should have been completed worth US\$10 million each. The project not only has cost overruns, it is also way behind schedule!

Let us now define formally:

*Earned Value (EV)* = The sum of the approved cost estimates for the physical work that was actually accomplished on the project and the authorized budget for activities or portions of activities that have been completed. This is also called Budgeted Cost of Work Performed (BCWP).

*Planned Value (PV)* = is the physical work that was scheduled or planned to be performed and the authorized budget to accomplish this scheduled work. This is also called Budgeted Cost of Work Scheduled (BCWS).

*Actual Cost (AC)* = the total cost actually incurred in accomplishing the work that was completed

We can now define appropriate indicators based on the above:

*Schedule Variance* =  $EV - PV$ . Is a Measure of schedule performance on a project, it indicates project schedule status vs. baseline schedule;

*Cost Variance* =  $EV - AC$ . This is a measure of cost performance on a project. It indicates the relationship of physical performance to the costs spent; and

*Cost Performance Index (CPI)* =  $EV/AC$  (%). Is a measure of the value of work completed compared to the actual cost or progress made on the project.

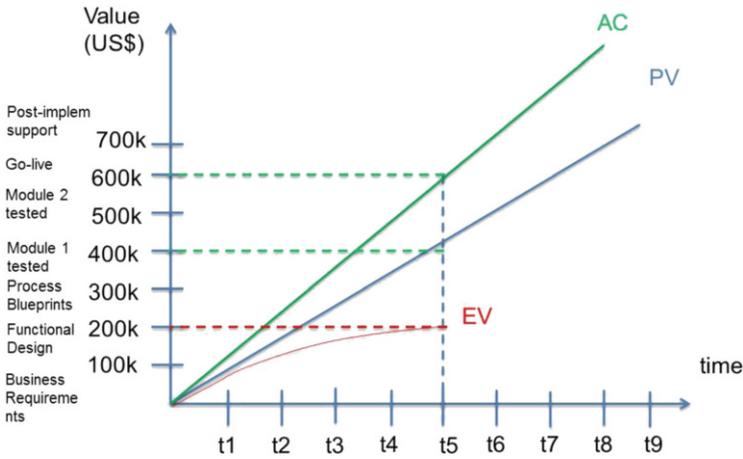
*Schedule Performance Index (SPI)* =  $EV/PV$  (%). This is a measure of progress achieved compared to progress planned on a project.

For CPI, if it is  $< 1$  then the project is having cost overruns, if  $= 1$  it is mark-on to budget, and if  $> 1$  then it is running below budget.

For SPI, a value  $< 1$  means the project is delayed, if  $= 1$  then it is just on-time, and if  $> 1$  then it is actually advanced vs. its baseline schedule.

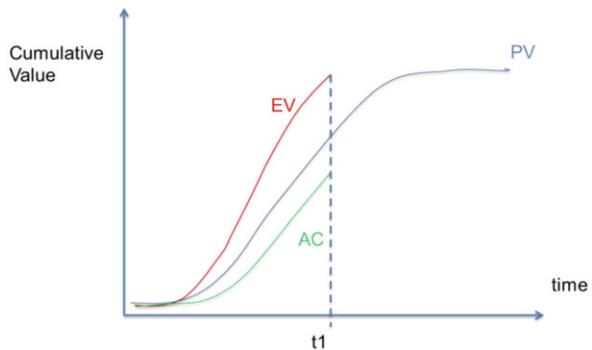
By making use of CPI, SPI and % completeness, a project manager has a very powerful tool on-hand because it marries scope, time, and cost into a single report. Nowadays, with the advanced use of project management tools, these indicators can be calculated automatically based on the project task % completion, giving the PM an unambiguous, objective view of how the project is actually doing.

Let us look at some further examples that illustrate the concept. For example, take an IT project which has defined deliverables and a corresponding PV as shown in the y-axis of the graph in Fig. 5.12.



**Fig. 5.12** Example showing EV, PV and AC

**Fig. 5.13** Project ahead of schedule and under budget



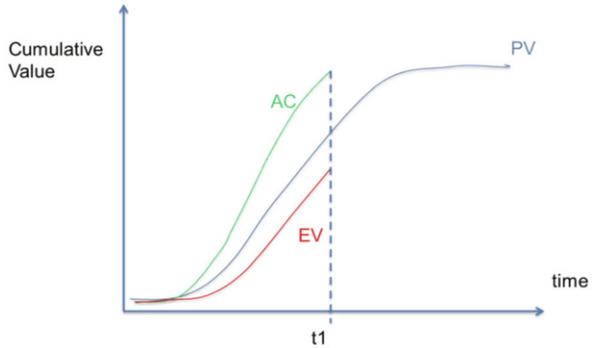
At time = t5, the planned work was to have module 1 tested, with a value worth US\$400k. However, at time = t5 we spent US\$600k, but actual work done was up to functional design only, with a value of only US\$200k only. Therefore:

- Project is above budget
- And behind schedule

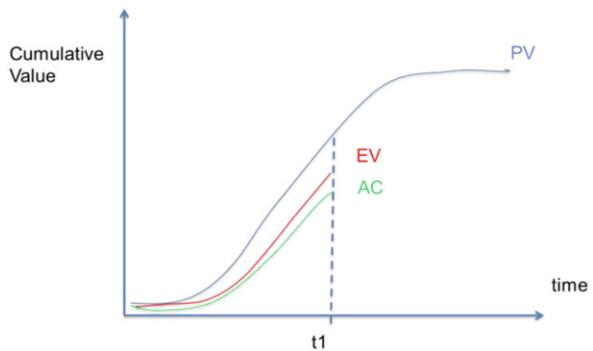
The power of earned value is that it translates scope into a value translatable into monetary terms. It is thus easier for top management to appreciate, as it usually prefers to talk of costs and monetary impact.

By having a chart with cumulative value vs. time, and plotting AC, EV and PV in the charts, we get the so-called S-curves which can quickly show how the project is doing. There are four possible scenarios as shown in Figs. 5.13, 5.14, 5.15 and 5.16.

**Fig. 5.14** Project with cost overruns and behind schedule



**Fig. 5.15** Project behind schedule but underutilizing budget



**Fig. 5.16** Project ahead of schedule but overrunning budget

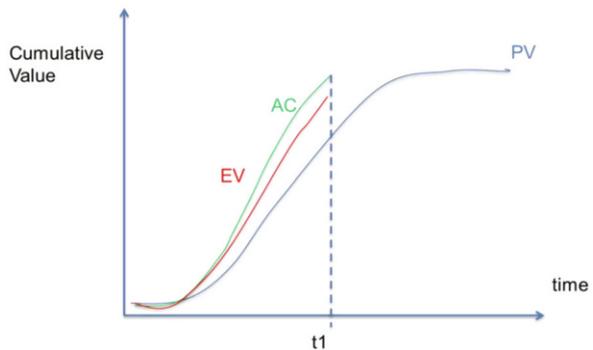


Figure 5.13: Project ahead of time schedule and under budget (which I think is mainly theoretical and belongs to science fiction!).

Figure 5.14: Project overrunning costs and behind schedule (probably a more usual scenario to many of our readers).

Figure 5.15: Project behind schedule but under budget.

Figure 5.16: And project ahead of schedule but overrunning budget.

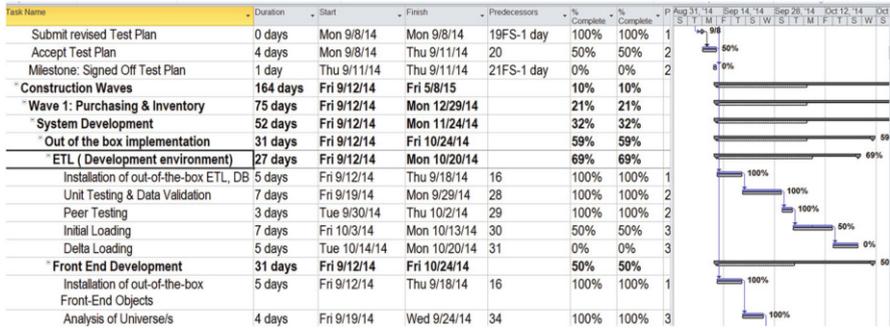


Fig. 5.17 Sample project plan with tasks and milestones

Of course, Actual Cost and CPI have no real meaning to the project if the project is fixed-cost (turn-key). In that case, only EV and SPI have relevance.

Scope, time, cost have been discussed, how can all these be put together into a meaningful monitoring and control tool? Advanced tools nowadays allow you to monitor these in very efficient ways, so that by plotting the different tasks with their interdependencies, and estimated duration, the baseline of the project is obtained. If the project is turn-key, a fixed amount is attached to this baseline, which is the cost of the project. Deliverables are also identified in the project plan (Fig. 5.17).

As the project progresses, the % completion of the task is input by the project manager, and the EV, SPI can then be calculated automatically by the project management tool and displayed, giving the PM an easy way to understand how his project is actually going. Projections can also be made for costs and time, using the current CPI and SPI to project what the total costs and total time to complete the project will be, assuming the current rates of efficiency (or inefficiency) are maintained till the end of the project. PMP (Project Management Institute 2013) has several techniques of projecting these. For our discussion, we merely take the simpler calculation. Firstly, let us define Estimate at Completion (EAC):

EAC = A estimate at Completion, is a forecast of most likely total project costs based on project performance and risk quantification

Where EAC is estimated by dividing Budget at completion (BAC), which was the original budget used during planning at project end, by the CPI:

$$EAC = BAC / CPI \text{ (cumulative till data date)}$$

Assumption here is what the project has experienced to date can be expected to continue in the future (same CPI throughout the project).

The same estimation can be made for the time component:

$$\text{Estimated Duration} = \text{Baseline duration} / \text{SPI}$$

$$\text{Estimated Finish} = \text{Baseline Start} + \text{Estimated Duration}$$

What this means is that using your current project (in) efficiency, based on SPI, we can project when the project will actually finish.

Resources can also be captured by such tools, such that assigning specific resources to tasks allow you to monitor % and utilization of your resources, as well as cost for the use of such resources. If the project is time and materials, you can also calculate Actual Cost based on the rates of these resources.

These tools also allow you to view project information in a variety of ways including Gantt charts, table formats, predefined reports for specific uses (resource usage, cost report, efficiency reports, etc.), and calendar views, among others.

We have reserved the most difficult and contentious for last, quality, how do we ensure it? The challenge with quality is that unlike cost, time and even scope, quality is very much project-dependent, customer-dependent, and can be very subjective. The key therefore is to make it as objective as possible, elicit agreement on it, so that all parties are aware of what is required of them, what needs to be attained, and ultimately, how they will be measured, and the project accepted. Let us face the reality, not all customers demand the same amount of quality. Some customers are obsessed with cost, and though they may say otherwise, are willing to accept low quality work for as long as it meets a low budget. This is precisely an intangible that is factored-in during the sales process by the vendor if he is sufficiently acquainted with the customer. If the vendor knows beforehand that the customer demands a high standard of quality, it will factor that in with a certain premium, as that is what is necessary in order to achieve the desired quality level acceptable by the client.

Ok, all that is well and good, but how can we really measure quality and ensure that it is being met? Main components to this are:

- Detailed scope
- Standards
- Documentation

Detailing the scope describes the concrete quality that is to be delivered by the project. Take as an example a scope requirement defined during the tender process:

- Software must be able to generate the bills for 100,000 customers

As compared to a more detailed requirement:

- Software must be able to generate the bills for 100,000 customers
  - Must be generated within a 2 h batch window
  - Must be generated in pdf format

- Output format must be user-flexible, with the ability to add graphs, pie-charts, historical billing data
- Must be able to print in full color
- Etc.

It is of course a major effort to define the quality components of a project, but is absolutely necessary if one is to ensure their delivery. As discussed earlier under scope management, not all aspects of the scope can be defined during the tender process stage, so it is a reality that scope is successively defined and refined as the project progresses, but once it has reached the end of the design phase, all its aspects must be fully defined, clear and agreed upon. Successive definition of scope components should be reasonable and agreed to by both vendor and customer, and not go against the content nor spirit of the tender documents; otherwise, this should be treated as an additional scope, and thus, a change request.

The second leg towards guaranteeing quality refers to the use of international standards and documentation. Standards such as CMMI, ISO20000, ISO9001, ITIL, PMP, Prince, may be required from the vendor, as a way to guarantee that at least awareness of international best practices exists, but of course, there is no guarantee that they will actually be used correctly. Standards will also exist in the customer organization which has learnt from the many years of experience running operations and projects. This may include coding and configuration standards as well as policies which should be given to the vendor for compliance. Standards set a general framework, but do not indicate the specifics that are to be used, which brings us to the third component, documentation.

Software is an intangible, and most hardware is intangible as well today. Think of it, hardware performance depends more and more today on the way it has been configured, set-up, and architected, which are intangibles again and are not captured by the hardware technical specifications. Hardware specs tell us nothing on these, and yet today, these intangibles are the make or break for how hardware performs. The conclusion therefore is that the quality of software and hardware depends on what and how services are performed on them, and this, being the ultimate intangible, can only be defined, monitored and controlled by means of proper documentation describing what is to be done or how it has been done.

Documentation type differs per project type (please see Sect. 5.2 for an extensive discussion of the documents), and this is a valued Intellectual Property in each organization. It is the PM's duty to define what is the relevant documentation for the project and use available ready-made standards, which may either be the customer's, the vendor's, or a combination of both, as agreed upon. If due to the type of project some additional documentation needs to be made or modified, then this is to be discussed between both parties and agreed upon. All relevant documentation should appear as deliverables in the project plan part of the deliverables checklist as discussed in Sect. 7.3, and monitored for compliance, content, and completeness. Non-acceptance of the documentation means the milestone has not been attained due to non-attainment of the desired *QUALITY*. Only when the project milestone is accepted has the project progressed with the necessary quality. It is of

course the duty of the PM to understand the content of this document, to read it thoroughly, and if not completely in the know, to consult other colleagues in his organization for verification.

A quick way for the project manager to monitor the quality of the project is by means of an issue registry, as well as a deliverables checklist. These are explained in more detail in Sect. 7.3, but in essence the issue registry is a project management document which registers any issue encountered during any moment in time in the project. The issue reflects here until it is resolved or cancelled (becomes non-relevant). The deliverables checklist is a list of all deliverables, documents, workshops, trainings, and the like that are part of the project; it complements the project management tool. All deliverables to be produced are registered in this sheet and, updated as they are submitted, approved or pending.

### 5.1.7 Risk Management

Risk management is the ability to foresee how events or circumstances can affect a project before they actually occur. It is thus important because by focusing on what may happen, one can proactively plan and develop a mitigation plan for them, instead of just reacting, thus reducing or mitigating their negative effect.

We commonly think of risks as being negative, however, positive risks exist too. For the former, we mitigate, eliminate or transfer the risk, but for the latter we enhance and promote its probability of occurrence. Positive risks have an overall positive effect on the project in terms of time, cost, quality, or all. Risk management is an inherent function in IT operations (and operations in general), but for the project manager, it is focused towards the outcome of the project.

Risks may further be classified according to certainty (Cleden 2009):

- Known-known
- Known-Unknown: partially known
- Unknown-unknown: totally unknown

For the first two risk types, project reserves (buffers) should be allocated. This really means that if they occur, these will have an effect on time, cost, quality, or on all of these dimensions. Time extensions can be mitigated by adding additional time buffers into the project plan baseline, which actually translates to cost as well, while quality impacts usually need to be addressed by rework, additional time to fix, or additional resources into the project, which again translates to cost. For this reason, buffers to be added to the project will usually be in the form of both time and cost, as these will cover for the occurrence of potential risks.

Unknown-unknown risks cannot be accounted for in any way, and so including it in project reserves to mitigate them would be extremely expensive for the project. For this reason, management reserves are usually allocated for this type of risks, meaning it is management that allocates for these additional costs at a corporate or portfolio level. These can be in the form of emergency funds, insurance, or expert resources that may be on standby for such purposes.

Risk management is not a one-time activity, but rather, a project-long activity which is continuously undertaken, much like the monitoring and control of the project. Risk analysis is best conducted having the different stakeholders in the project participate in brainstorming sessions to identify risks, as each will have his/her own perspective of what are the significant risks. Risks also change as the project moves along its different phases, so that risks identified during the analysis stage may be different from those at the design stage, and may be different from those at the testing phase. Risks may move in terms of relevance, some being totally eliminated, others increasing in probability, while others still ceasing to be relevant. As mentioned during the start of this chapter, risks are greater at the start of the project, yet are hardest to identify at that point in time. It is however when the PM has greatest influence and time to actually mitigate or enhance a risk. It is therefore recommended that risk analysis start early in the project, otherwise risks may be more easily identified in the later course of the project, but with very little possibility of actually mitigating them. Risks are also cheaper to address at the start, because they may require less rework if work has not advanced too much into the project.

Risk analysis may be qualitative or quantitative. Different projects will require deeper and more or less effort in terms of risk management. If the project is inherently risky, then more time and effort should be devoted. Typically risky projects are those that affect business process across a wide number of departments, and which have a large user change management component. Technical projects, unless these are relatively untested technologies, typically carry the least risk.

In order to better understand how risks may affect a project, risks should be classified for probability and impact. Both probability and impact may be classified as High, Medium or Low (or any other alternative scoring system may be used), By sorting risks on their overall ranking, High-high risks, meaning risks that have a high probability of occurring and a high impact on the project should be the first to be addressed for mitigation. At the other end of the spectrum are the low-low risks. Please take note that in all this discussion, we focus on negative risks, but the same technique is applicable to positive risks, save that they are to be enhanced rather than mitigated. A sample risk registry (Low 1994) template can look like that of Table 5.3.

Fields in this sheet are a description of the risk, its probability, its impact, mitigation identified, person or team responsible for the risk mitigation, as well as the date identified. In the example above, the phase of the project was identified as well, so that specific risks are identified per project phase. After that phase has passed, most of the risks associated with it become irrelevant, either because they were mitigated, accepted, or simply occurred. Risks can be acted upon in several possible ways:

- Accepted: meaning, no action is taken
- Mitigated: an action that will either enhance (for positive risks) or decrease (for negative risks) its influence
- Transferred: by transferring the risk to another party that is better prepared to deal with it.

**Table 5.3** Sample risk registry

No.	Project phase	Risk	Probability	Impact	Mitigation	Date	Assigned to	Affects
1a	Training Planning	Poor Quality of Trainers	M	H	Training on Presentation Skills; Get feedback from HR on the Profile of Trainers (Quality); Core Team	29 Jul	Homer	Quality of training
1b		Quality of Training Materials	L	H	Review of Training Materials; Training Deck; Addition of Talking Points to the Training Deck Update as of July 9 > Talking points submitted as of July 9. For review and update of Noel and Joan		Homer	Quality of training
1c		Availability of Trainees	L	M	Additional Trainings to be provided (as Buffer); Promoting Project to the Business Users so the Dept Heads can push this proactively		HR; Francisc	Project acceptance
1d		Availability of Trainers	L	M	Promoting Project to the Business Users so the Dept Heads can push this proactively		Francisc	Project acceptance
1e		Retention of Basic Computer Knowledge	L	L	Retraining of Basic Computer Knowledge; For those trainees attending without enough computer knowledge, they will have to be advised to retrain first then be pooled for the Additional Training sessions		HR	Project acceptance

(continued)

Table 5.3 (continued)

No.	Project phase	Risk	Probability	Impact	Mitigation	Date	Assigned to	Affects Timeline
1f		Lack of Training Equipments (Computers)	L	L	Sir Noel to monitor the delivery of the 12 additional computers for Training		Noel	
1g		Retention of WMS Training	M	H	Users Access to QA System' Contractor to load the data Update as of July 9: > UAT Testers were given access during the UAT		Contractor (Julia)	
2	Change Management	Resistance of Process from Users During Training	L	H	Roadshow for Business Units Update as of September 20	August 6-9 (before)	Francisc	
2a	Data Conversion	SAP: Accounts, Contacts, MRU, Zone—Quality of data like Duplicates, Inconsistent Data	L	H	Julia to provide Homer the list of errors during import of data to dev (06/27/2013)		Julia/Homer	

Generally, only low-low risks can be accepted, all others should warrant action in order to deal with them, and definitely high-high risks need mitigation action, or a transfer. Mitigation also needs to be well thought of, and is not the responsibility solely of the PM. He/she is the person that needs to call for a risk assessment meeting, but each and every party and stakeholder is to participate in this endeavor, as it enriches the discussion and gives many different views for the same project. Risks can be of any nature, they may be technical, project management related, task related, change management, training, logistics, and others. No risk identified should be discarded, in fact, discussion should be encouraged so that all risks identified by the team are to be enumerated, afterwards, these are then revisited one by one and their corresponding probability and impact updated in the registry. Very low-low risks can be discarded altogether. It is for this reason that the risk analysis and issuance of the risk registry cannot be done mechanically, as the discussion itself is probably of greater value even than the output of the above table, as it makes everyone on the team aware of risks that they probably would not have been aware of in the first place.

### 5.1.8 Knowledge Management

Knowledge management refers to the activities leading to the build-up of a knowledge base that can be used not only for the project, but more often, used for subsequent projects as well. It is a repository of “lessons learned” so to speak, so that subsequent projects be guided to avoid identified pitfalls, learn to leverage on positive aspects, as well as refine the tools used to manage the project (project governance). Knowledge Management is of primordial importance if project management is to be a core competency of the organization practicing it.

Knowledge base, or the capture of this knowledge, can be in many forms. For IT projects, it comes primarily in the form of:

- Documentation—as described in Sect. 5.2
- Project Management tools—in terms of templates, configuration and utilization of these tools
- Methodology—which refers to the manner in which the project is executed and managed

One of the most immediate and apparent benefits of knowledge management is the recording of how project issues were resolved. These details, once accessed by the Operations team upon turn-over will help them in not repeating past mistakes, as well as giving them information on the resolution of issues which may reoccur.

Documentation, project management tools, and methodology are all existing knowledge assets in the organization, but by further refining these after every project, they are further sharpened and improved, capturing the lessons learned from each project.

Modern document management system (DMS) tools help incredibly in the management of one's Knowledge Base (KB). Modern DMS not only allow manage different permissions over documentation such as ability to read, print, view, upload and approve, but they also incorporate powerful search capabilities which allow users to search through the KB by providing keywords and terms, the DMS presenting the best matches. Thus, for issues encountered before, a user may search through all the material to get most relevant KB documents by indicating the type of issue or key-word description of what he wants to search for.

### 5.1.9 Communication Management

Let us revisit some of the risks identified during the scope management section. We enumerated samples of factors that can affect scope in terms of risks that can lead to a change in scope in the middle of a project:

- End-user changing his/her mind
- A senior executive having different ideas on what should be done
- Project creep
- Person approving is not the right person to approve (or does not understand the actual needs)
- Unruly behavior by the end-users
- Supplier starts development work without getting a sign-off from the users

If you look at this list above, there is little one can do to mitigate these but to properly communicate to the different stakeholders so as to avoid having these risks. This example was used to emphasize the importance of communications, which although often cited, it is sometimes forgotten to be a key component of project management.

Oftentimes, communication management is something that comes naturally to the Project Manager, without having to undertake an explicit communications management plan. In many instances, this may be sufficient, but for large, complex projects with many stakeholders involved, a more planned and coordinated effort may be needed. It is not just who needs to be informed, but the frequency and medium in which the information is to be disseminated identified as well. One approach is to conduct a communication matrix, which describes how communication is to be conducted, as shown in Table 5.4.

Next is how to inform the stakeholders, there are many different media which may be used:

- *Project meetings*—these are regularly defined meetings which involve those stakeholders most directly involved in the project, usually the key business users, project managers, as well as the key IT personnel involved in the project. Additional stakeholders may be invited if the topic is of concern to them. This meeting is to regularly update the team on the progress, discuss next steps, ask for

**Table 5.4** Sample communication matrix

Stakeholder	Content	Frequency	Manner
Project Manager	Project updates	Weekly	Physical meeting
Steering Committee	Updates and key points for resolution	As-need basis	Physical meeting
Key users involved in project	Project updates	As-need basis	Physical meeting
	Weekly project updates	Weekly	Portal
Project sponsor	Project status	Monthly	Physical meeting
HR	Change management and changes in table of organization, roles and responsibilities	– After blueprint – Before go-live	Physical meeting
Finance	Discussion on change of financial report contents	After blueprint	– Email blueprints – Meeting if required
General users	General advice on the project	Before go-live	– Email blast – Details in portal

involvement and resolve arising issues. The risk registry may also be discussed and updated in this meeting, together with the project plan, issue and request registry.

- *Steering committee meetings*—steering committee meetings may be preset in schedule, or may be called for as the need arises. The main purpose of the steering committee meetings is usually to inform the top management stakeholders of the progress of the project, seek approval for major decision points which need to be made at their level, or to ask for guidance and resolution in case of contention.
- *Project reports*—which may be distributed to those identified as “need to know”. Project reports may contain a summary of the key indicators, % completion, SPI, CPI, project plan updates, risks, issues, requests and identified next steps, including those needed to address the risks and issues encountered/identified.
- *Email*—can be used to disseminate in a simple way the project reports and other information, without having to call for a meeting.
- *Portal*—can be used to upload all the documentation and give access to relevant parties.
- *Scorecard*—can be a summary of project performance based on pre-defined metrics which can be used by higher management to monitor project progress. This can be loaded into the portal, emailed, or an on-line reporting tool used where it may be accessed by the different parties
- *Roadshows*—one important aspect in user change management is to keep users informed, involved and make them feel they have a stake in the project being

rolled-out. Roadshows are one way to inform users in a relaxed manner, where the project highlights are presented, their involvement highlighted, and their questions and concerns answered.

- *Posters, magazines and hand-outs*—to drum-up awareness and support to the project, highlighting the benefits the project will deliver to the organization and to individual departments and users.

It may seem apparent as well, but different content, level of details and media need to be used for different type of stakeholders. This is commonly ignored, to the detriment of the communication message's effectivity. As a general rule, the higher up one goes into the management organization, the less details and the shorter the messages should be. The main focus to upper management should be related to aspects related to the overall business, as top management is busy with running the business, so its attention span is short if they cannot relate it to the main business and its bottom line. Messages should be concise, direct, and the petition for guidance or decision clearly defined.

On the other end of the spectrum, users will be more concerned about how the project will affect them personally in the way they do business. Will it make their work easier? Will I have to learn how to use a new application? Is there a new procedure? Why was it designed that way? Will I have a job at the end of the project? Will my job responsibilities change? These aspects should not be taken lightly as end-users have much influence in the success or failure of the project.

As such, the message contents should be changed according to the intended audience. As a guide, some sample audiences are:

- key executives
- key users
- general users
- suppliers
- project team

This details who should be informed, through what means, how often, and the key content that should be included or highlighted. It may seem obvious, but it is important that whenever a meeting is called for, the agenda for the meeting be clearly stated, so that the stakeholder knows whether he has to devote his valuable time for it, or if he can delegate it to someone from his team.

One part of communications management involves that of identifying stakeholders, which may by itself be a challenge because though most stakeholders may be apparent, some may not be, and may have a major impact and influence over the project. Stakeholders can come in many different forms:

- Senior Management (in general)
- Department Heads whose process the project touches on
- Project Sponsor
- Business Process Owners

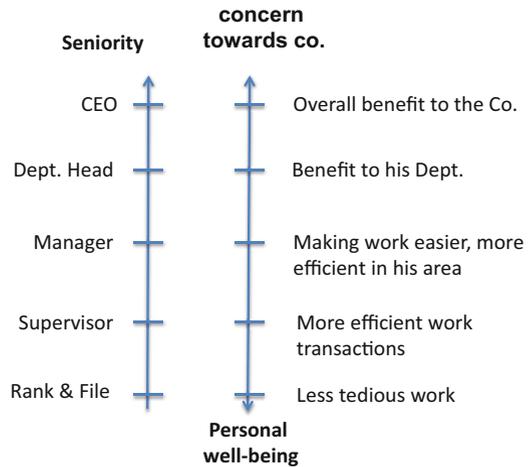
- Key users
- General user populace
- Suppliers
- Project Team
- IT's O&M team
- IT's Senior Management
- Outside customers

Failure to identify a stakeholder may result in no (or scant) communication being made to the stakeholder, which may result in his negative reaction once he finds out that he should have been more involved and possibly consulted in the first place. Also, seniority may not be the only factor to qualify a person as a stakeholder. It is fairly common to find in many organizations a person without the formal title but still respected as an “expert” for particular processes, so that involving and consulting that person eases the whole project implementation. On the other hand, some senior manager may not have a direct influence over the process because it does not touch his department, yet for some other reason, may want to be involved and contribute to the project, so it also pays to take this person into account in the list of stakeholders. All this identification and planning on how to manage the stakeholders is usually done mentally by the PM, however, if the project spans across many departments and is quite complicated, the use of the communication plan may be called for.

One of the objectives in managing stakeholders is in proactively changing resistant and neutral stakeholders to supportive ones, and possibly bringing up key supportive stakeholders (especially if in senior management) to that of leading and sponsoring the project. One of the key factors is communication, and as explained above, communication styles vary according to the stakeholder in question. As all stakeholders are persons, it is important to be aware of their personal stake in the project, and try to align this to the overall objective of the project. Generally speaking, the more senior a stakeholder is, the more his concern will be towards the general company's benefit, while the lower management ranks, would focus more on his own personal well-being, this represented in a diagram in Fig. 5.18.

As such, the communication delivered to each stakeholder should also take into account that mix of company benefit-personal well-being. At the CEO level, little concern would be given (usually) to the personal stake of each employee (of course, for as long as the expectations are within a reasonable level), but more towards what efficiencies, revenues and cost reductions the company can achieve. On the other hand of the spectrum, a rank and file employee would be eager to know how this project will actually simplify and make his work less tedious. Thus, when explaining to each party in his particular venue, messages should be delivered accordingly, keeping in mind the audience at hand.

**Fig. 5.18** Stakeholders' seniority vs. stake



## 5.2 Project Documentation

Generally speaking, the type of documentation to be prepared for each project depends to a large extent on the type of project and software (if any) to be implemented. Purely technical projects are simpler to document and manage, as they do not involve business process design, and the users are commonly restricted to IT personnel. On the other end of the spectrum are software implementations that touch core business processes needed in the day-to-day operations of the business and whose processes span across several departments.

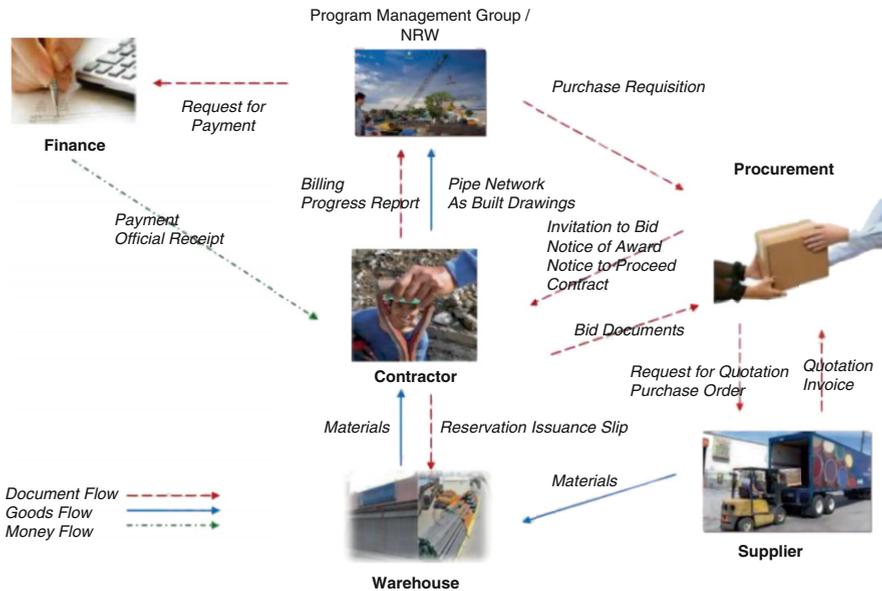
We have subdivided the type of documentation depending on the phase of the project: analysis, design, build, and cut-over.

### 5.2.1 Analysis

Analysis refers to the phase in which the vendor is getting sufficient information from the customer organization's users and IT, in order to come up with a proper design. Typical documentation at this stage includes:

- Minutes of meetings—in which the discussions are transcript
- User requirements document—which summarizes in an organized manner, the requirements from the user, usually arranged by process or main functionality, and explains in narrative format these requirements, and enumerates them.

In the analysis phase, it may be advantageous to create mock displays so as to give the users a better feel of how the resulting system may look like, especially if



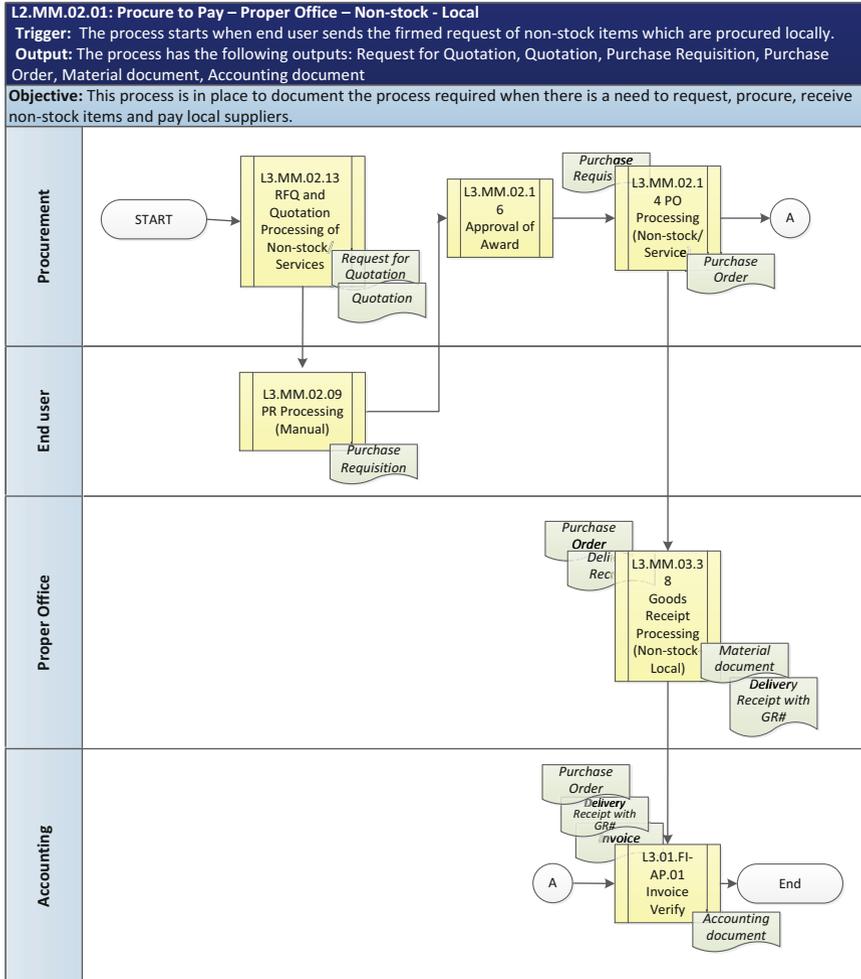
**Fig. 5.19** Sample Level 1 process diagram showing a “Plan to Construct” typical process

display outputs, report formats and the like are important part of the deliverables. If the project entails a reporting system, a mock report in excel or dummy dashboard will also help the user understand how his results would look like, and critique these before actual development starts. For some other projects, a mock transactional display, the so-called Conference Room Pilot (CRP) may also be used.

### 5.2.2 Design

Business process may typically be captured using flowcharts which show the flow of the process as it progresses through different departments and users. It also identifies conditions, decision points, and outputs. Process flowcharts however, may be defined at differing levels of detail, so that a common understanding on what level of detail is required needs to be agreed-upon at the project start. A sample classification on the level of detail to be used is:

- *Level 0*: a list of involved processes with a brief description
- *Level 1*: a diagram showing the highest level process interaction between different types of users shown in diagram form (see Fig. 5.19). This does not explain the chronological order of the process steps, but merely illustrates how the general philosophy of the entire process works.



**Fig. 5.20** Sample Level 2 process diagram

- *Level 2:* process flowchart describing in sequence the tasks involved for each particular process. A single process is typically depicted in one process flowchart and may span across several pages, a sample of which is shown in Fig. 5.20.
- *Level 3:* a more detailed process flowchart in which each task defined by the level 2 flowchart is further broken down into transactions as undertaken in the system. Thus, as an example a Release Purchase Order task in level 2, which may be represented by a single function block is here further broken down into details such as, “Prepare Purchase Order”—“Approve Purchase Order”—“Release Purchase Order”—“Print Purchase Order”. Figure 5.21 shows a sample with this level of detail (for SAP, this level would correspond to the T-code level).

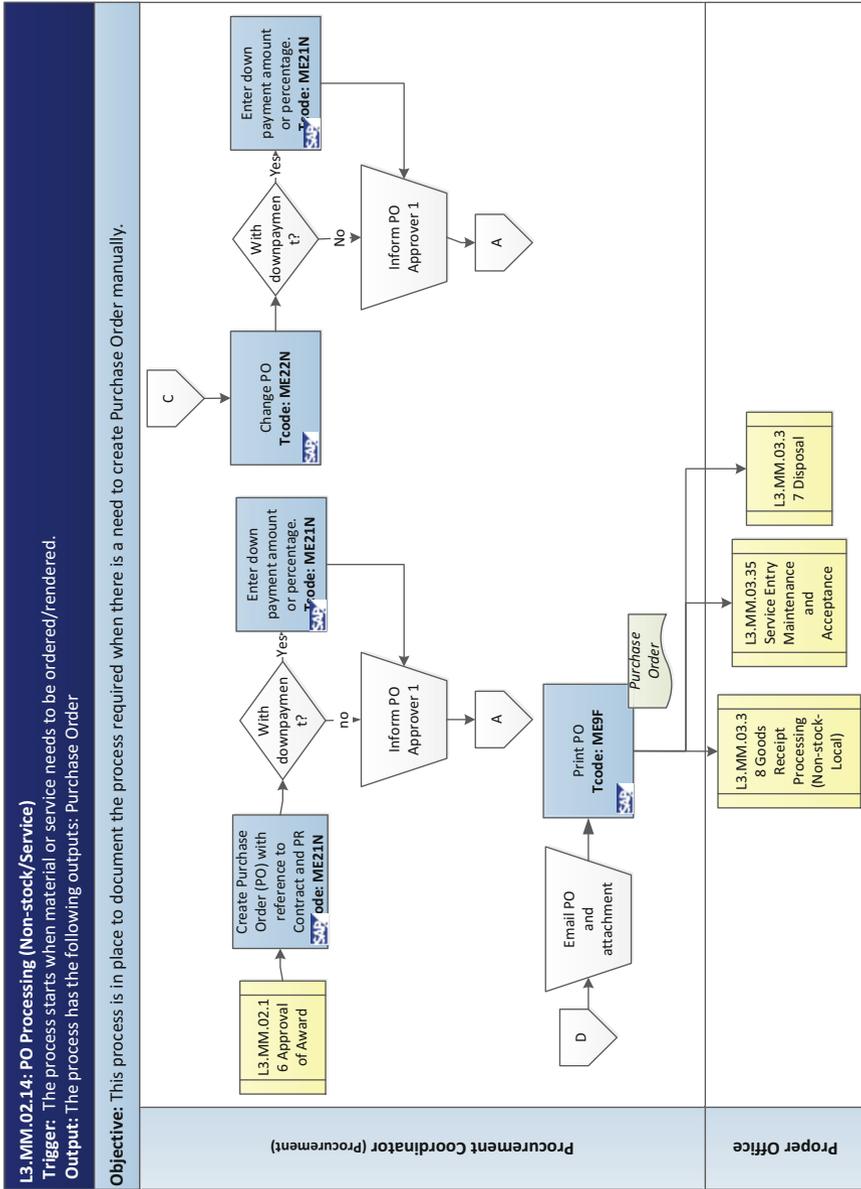


Fig. 5.21 Sample Level 3 process diagram

- *Level 4:* Work Instruction level, is a step by step depiction of how a user is to transact. Typically includes screenshots and an explanation of the parameters and selections the user is to make in transacting. This documentation is usually prepared for the Testing and Training phases, and also in the User Manuals.

The process of designing and documenting the processes is typically an iterative one, in which each successive level is signed-off before proceeding to a more detailed level, guaranteeing alignment.

Aside from process, a document should also be used for defining how the user interface (UI) will look like. This may be more or less important depending on the type of project. For reporting, billing, web interfaces, presentment, sales and marketing systems, this may be of primary importance, as the appearance is just as important as the content. For standard systems such as ERPs, in which the interface is more or less fixed, this is less important (and flexible), unless it is tied directly with productivity factors, such as how long it takes to transact. In such cases, mock displays should be presented to the user for sign-off, including content fields, color schemes, layout, and aesthetics.

Some softwares may not be so heavy in terms of process; however, they conduct other functionalities which also need to be signed-off by the customer. For example, document management systems, portals and the like, may carry very limited process flows, but functionalities such as functions made available to the users, search criteria, metadata, fields to be stored, selection menus, and others need to be agreed. A functional design document is used for this purpose. This document is seldom standard, as it is highly dependent on the type of software being utilized, but it essentially captures:

- Overall functional architecture: includes different modules to be used, as well as interfaces to/from other systems
- Functions, attributes and forms to be used. This may go up to the level of describing each field to be used and their possible values.
- Process flowchart: if process is simple enough, it may already be included into this functional design document
- Layout of user screens (if possible)
- High-level description of interfaces used. Interfaces may then be detailed further in a separate document
- Roles and Permissions

Its counterpart document is the technical design document, which captures all technical (infrastructure and technology components) setup information. This document is essentially reviewed by the IT personnel only, for conformance with the company's standards and policy, ensuring that the solution once implemented, will be in accordance with company IT standards. IT will also check for appropriateness of the infrastructure allocated, though this also needs to be in accordance with the software vendor's technical specifications. This document is also highly dependent on the solution and product being implemented, but typically contains:

- *Overall technical architecture*: a diagram showing the different software components, in what servers these sit, network components with their interconnections and configurations, description of the different type of servers needed (application server, database server, web server, management tool server, etc.), as well as any special components utilized (load balancing, High availability servers, etc.).
- *Description of the different environments to be used*: including Development server, QA/Testing server, Training server, Production server, whichever are applicable.

If this is a technical project relating to infrastructure, this document will be much more exhaustive and cover aspects such as:

- Configurations and rules implemented into the appliance
- Sizing calculations including basis and assumptions used for the calculations.

For custom development programs (which are a subcomponent of the main project), a combined functional and technical design document is usual called for, in which:

- Descriptions of the functional requirements for the program are given. This entails an explanation of the data that is used, how it is to be processed, and the resulting output. It may also include a process flow, if relevant.
- Technical details of how the program code is to be executed. This will include data, table, and field details, objects and functions called by the program. If there are custom tables that are created, these will also be described.
- Error and exception handling processes

For non-transactional systems, the design documentation is very different, as it does not describe process, but rather, how data is processed so as to produce the desired outputs (reports, dashboards, etc.). As such, several components need to be defined:

- *Architecture*—describes the different software components and how these interact. There are many ways of producing the outputs, so the overall architecture needs to describe these. Does it make use of Business Intelligence tools? What type and how is data stored by these front-end tools? Does it have a datawarehouse for storing data or is data extracted directly from the source systems without a database staging area? How does data flow from the source transactional systems to the outputs? Are ETL tools used? Where is metadata stored? Are there any other advanced functionalities/modules used such as data mining, sorting or parsing tools? This document should give the reader a general idea on how the whole project is to be setup and will work.
- *Outputs*—description of the front-end screens which the user will be seeing, including reports, dashboards, and other displays. This should also include a

functional and technical description of how these reports and front-end interfaces are stored in the system. As MOLAP and ROLAP structures differ considerably, the manner in which these reports and their corresponding data are stored shall differ, depending on the tool.

- *Datawarehouse data model*—a detailed description of tables, fields and what these represent, as well as the overall structure type of the data model (star, snowflake, etc.)
- *Data mapping*—a description of where data is sourced from, how it is transformed (processed), and where it is stored.
- *ETL or loading scripts*—description of the different scripts used in obtaining the data. Each script should be described functionally as what it does on the data.

Other types of projects will have their own particular documentation, and this should be agreed upon beforehand. The basic precept of the documentation is that *what will be done* should be described *before it is actually done*, so that there is no loss in effort during the build phase, by having the customer organization agree beforehand. Of course, detailed design documentation is in itself a lengthy process, so that the overall design should be first discussed and agreed upon. Thus, the general philosophy is to go from general documentation, and once this is accepted, move on to the details. Failure to do this may result in costly rework.

### 5.2.3 Cut-over and Go-Live Phase

Once the solution has been built (or nearly so), the focus now is on the different steps leading to the go-live. Cut-over requires special documentation and procedures by itself (see Chap. 6 which explains cut-over). The exact documentation to be produced depends on the nature of the project, and thus, it is the project managers that need to come-up with a cut-over plan. Generally speaking, it should take into account the following:

- *Data migration plan*—describing how data will be migrated into the new system from the legacy system or other data sources
- *Test plan*—this is a document describing in high level how the new system will be tested, by whom, and how (high-level). The basic precept of this document is to answer, “How will the outputs of this system be confirmed as correct?” and “What are all the scenarios which I need to account for in accepting the system as correct?” It is a high-level document, meaning, no details will yet be given on what the actual test work instructions are, as it is constructed so as to confirm that the overall approach is correct and complete. Verification on how the outputs are correct necessarily needs to be identified in this document, so as not to leave it hanging till it is too late. Some typical ways of verification include:
  - Comparison of output to a legacy system’s output which is known to be correct

- Manual calculation of outputs
- Loading of dummy data with known output
- *Test scripts*—these are the details on the test plan, and indicate work instruction level of scenarios to be tested, which will then be executed by the testers.
- *User manuals*—these should be ready in time for the user acceptance testing and the subsequent training. For good user understanding, work instructions are necessary but not sufficient, as it is important for users to understand not only how to conduct transactions mechanically, but the reason why such transactions are being used in the first place, thus, an overview explanation of the process from the users' perspective is also necessary.
- *Operations manual*—this is usually a forgotten document which is necessary by the IT team that is to operate and run the system (ITOM). Typically, these are batch processes which need to be undertaken in order to produce the desired outputs. Examples of this are batch billing processes, batch interest rate calculations, regular report generation, as well as regular process monitoring functions.

#### 5.2.4 Closure

Post-go live support kicks in the moment the system goes live. The structure and lines of support will of course depend on the setup established, as well as the contract between the vendor and the customer organization; many different forms are possible as explained in Sect. 6.7. In any case, the trigger on when the vendor's support role ceases and the criteria for such trigger should be clear upfront to both parties, and a formal document indicating the end of the post-implementation support, which usually goes hand in hand with the project, is then signed-off.

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### 5.3 FRICEW

Taking a page from a common definition used in SAP methodology is the term FRICEW (also called RICEFW or RICEF). These refer to customized components in an application and stand for:

- *Forms*: input screens for users
- *Reports*
- *Interfaces*
- *Conversion*
- *Enhancements*: these are particular to the application, but generally are modifications over standard code
- *Workflows*: in some applications, this may not be considered a customization, so it would depend on the application.

In SAP, these are the components customized using ABAP programming, or in other words, these are the typical components which are customized using code

(vs. configuration of the application). Why do we make special mention of it here? Well, it is a good general strategy to minimize customizations and coding for several reasons:

- *Coding is error-prone.* This means that all components with customized code take time to develop, test and thresh-out all detected errors. Testing is particularly time-consuming, and there is always the big risk that not all scenarios have been tested so that bugs in fact show up once put into production.
- *Customizations are not supported during application upgrades.* This means that all custom code has a chance of not working once the core application is upgraded. What this means is that every upgrade would need exhaustive testing on the customized code before deployment to production. What this also means is that anything that does not work would need recoding (and hence, retesting), a patch from the application vendor to fix the issue, or a work-around. All these take time, so that this actually delays the release to production of the upgraded version.
- *No product support on custom coding*

FRICEW therefore needs to be monitored and minimized. One must be absolutely sure that the FRICEW proposed is: (1) really needed; and (2) not possible by means of configuration. The first means that the PM needs to rationalize requests from users (and consultant). There is a natural tendency for users to want a process that is exactly or close to what they are currently doing, but the question is if this is an industry best practice, and whether it really makes sense given that one is migrating to a standard package. The second aspect is really a limitation in the know-how of both the PMs and the team implementing the application. If they are not aware of how to execute using standard configuration, the tendency is always to customize. It is recommended to consult application support, public blogs and even other alternate sources of support before making big decisions and conclusions to customize.

As such, it is important that any program FRICEW as well as any other additional customizations be reported by the customer PM to the portfolio manager and even the CIO, if required by the company IT policy, to seek approval for their undertaking. This highlights the importance of screening all customizations before undertaking them.

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## 5.4 Implementation Strategy

The riskiest implementation strategy is of course the big-bang approach, in which the solution is released into production for the general populace. For some projects, this may be the only possible way, as it may be impossible or impractical to have systems or two different processes working in parallel at the same time. This big-bang approach is however, the most difficult (if not impossible) to roll-back, and also, launches you into a state of immediate urgency as all incidences discovered after the go-live need to be expedited, much faster than if the users would have an alternative environment to work in.

Incidences after a go-live are normal, but that does not mean they cannot be minimized. There is no substitute for good, exhaustive testing. At the same time, the more contained the release is, the more room and time there is to detect issues, and the easier it is to resolve them.

If possible, alternate strategies to the big-bang approach can be applied, for example, by having a pilot deployment before proceeding to the general populace. This pilot can be chosen in accordance with a geographical location or a concrete department first. Oftentimes, we may choose a guinea pig department to pilot, and IT is usually a good candidate for this due to its maturity in terms of computer knowledge.

A phased approach may also be employed, wherein the whole system is released to production, but only limited modules or functionalities are made available to the general public so as to ensure proper and smooth transition.

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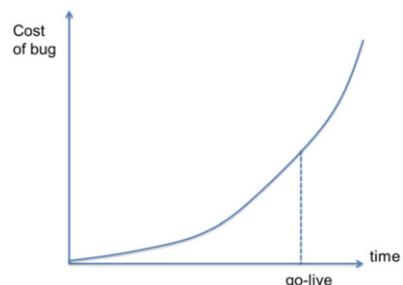
## 5.5 Testing

Testing involves the thorough examination of software, or its modules/components to check if it actually performs according to expectations. One of the challenges of any IT project, is that the cost of a bug increases exponentially over time, so that the later in time it is detected, the more expensive it is to fix, and the more negative impact it has on the company's operations or project as shown in Fig. 5.22 and Fig. 10.11.

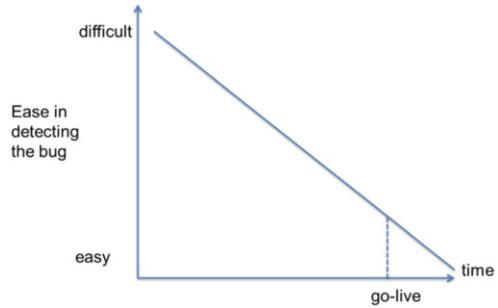
Cost of fixing the bug is even greater after going live as it now has a direct impairment on the company's operations. On the other hand, the ability to detect a bug is more difficult at the beginning, but decreases over time as the project progresses as shown in Fig. 5.23.

So that it is best to detect a bug early, yet it is more difficult at that point (also because specifications may not be completely clear and/or understood by the vendor), and is also least costly to address. As a general rule then, the earlier the testing and the more exhaustive, the better for the project and the least costly. Bugs detected only after go-live will need an extension of all the resources involved in the development of the module, and may require re-doing many of the initial steps (functional design, configuration, coding).

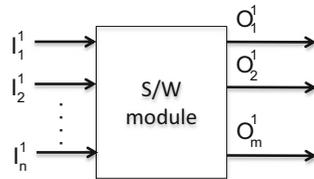
**Fig. 5.22** Cost of a bug vs. time



**Fig. 5.23** Difficulty in detecting a bug vs. time



**Fig. 5.24** Software module showing Inputs and Outputs

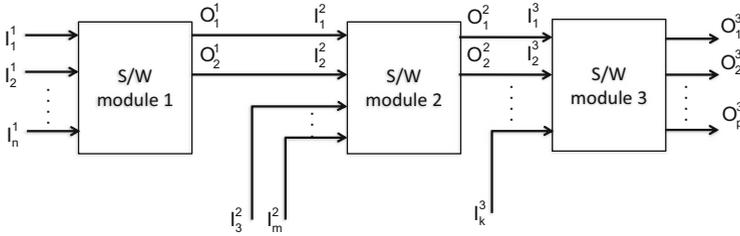


There are many types of testing, depending on the extent and manner in which the testing is to be conducted. The type of testing to be undertaken shall depend on the type of project, budget and time. Some types of testing may be required and made mandatory, as will be pointed out later in this section. Some typical types of testing are:

- *Unit testing*: in which a software module is tested to ascertain that the function for which it was designed for is performed correctly.
- *Regression testing*: testing undertaken in which the new module implemented/enhanced is tested to verify that it does not cause faults within its module or in other parts of the software. It is also used whenever a new patch or fix is applied to resolve a known issue.
- *Integration testing*: In which the module is tested in conjunction with the other modules of the software to verify that it functions correctly as a whole.

Testing is a topic all by itself which merits specific study and understanding. One of the challenges in testing is that given a software module with  $n$  distinct inputs and  $m$  outputs, all possible combinations of the inputs must be applied to ascertain that testing is comprehensively complete (assuming here that module has no memory retention, and is purely combinatorial) as shown diagrammatically in Fig. 5.24.

Now imagine that each input may be an integer value of  $0..9$ , then to test the module exhaustively, we will need  $10^n$  different combinations, so for a 10 input module, this would give 10 million combinations. For integers in the range of 256, the combination would balloon to more than 1208 billion-trillion combinations. If the inputs would be text strings, then you can easily see that the number of



**Fig. 5.25** Example for three cascaded modules

combinations would indeed be intractable. The module above represents what occurs during unit testing. Now take a scenario in which integration testing is undertaken for three modules as shown in Fig. 5.25.

In this figure module 1 has up to  $n$  inputs, module 2 up to  $m$  inputs, and module 3 up to  $k$  inputs. Not all inputs for modules 2 and 3 are directly controlled by the user, as these proceed from previous modules' outputs. This complicates testing even more, due to the controllability of inputs to the modules, aside from the combinatorial issue on the possible inputs. A further issue is whether intermediate outputs (the  $O^1$  and  $O^2$  series) between modules are at all visible to the tester, for if they are not, any error occurring will only be detected in the outputs of the last module. If there are many modules which are being tested for integration, it can become quite complicated to detect which module is actually causing the error.

Due to the limited number of combinations that can practically be tested, the test scenarios are selected based on their being a good representation of the many possible combinations, such that by using these test cases, they will most likely bring out errors in the modules (if any). Having said this, this is more of an art rather than a science and ideally, requires knowledge of the business processes and/or functions embedded in each module. As such, the best personnel to design the test cases are in fact the functional users of such modules.

Furthermore, two types of tests exist based on expected results:

- *Positive testing*: the most common, in which inputs are given to each module and the outputs are checked to ascertain that they result as expected.
- *Negative testing*: often forgotten, but very important. Testing a scenario in which the module is not to proceed normally. Testing is done so as to verify that it indeed does not proceed; it should trigger its exception-handling procedure, which should log sufficient details for proper identification and handling of such exceptions.

As a very simple example of negative testing, take the preparation of a purchase order. One may test that it actually does not proceed with the release of the purchase order taking into account several scenarios, such as:

- Person has no permission to generate the purchase order
- There is no Purchase Request approved for the PO
- There is insufficient budget

For positive testing:

- Purchase order proceeds in its generation under different scenarios
- Purchase Request approval actually proceeds to the generation of the PO

Negative testing is important as in actuality the software should really be able to handle all possible scenarios, not only the ideal ones that are thought out in a contained environment. Once more, the best personnel for designing negative test scenarios are the functional users of the system.

As explained in the cut-over section, testing is perhaps *THE* most important activity to ensure a smooth transition into production. A few guidelines:

- Test cases should be comprehensive
- Test cases should cover both positive and negative test scenarios
- Unit testing and integration testing should be first performed by the vendor before endorsing for User Acceptance Testing (UAT)
- During UAT, the test plan and test scripts prepared by the vendor acts as a guide, however, it is very much encouraged that the users think of additional scenarios (positive and negative) and test these to make the testing as realistic and exhaustive as possible
- The test plan is the first document to be reviewed for sign-off. This document is explained further below. The important aspect is that the test plan be comprehensive enough. For integration testing, it should clearly define what procedures will be used for testing end to end.
- Test scripts should be based on the test plan. Each test script document is a compendium of test cases.

A test plan is the first document that needs to be drafted. Ideally, it should be made early, even in the design phase, because it gives a clear idea on how outputs are to be considered correct (and incorrect). This may seem obvious, but it is not so. Additionally, it must state who will test, and using what data. Typically, the ways to validate software outputs during testing are:

- Comparison of outputs with that of a legacy system which is known to be correct. This however, is not always possible, even if such legacy system exist, as any change in the business process of the new system, however small, may result in differing outputs. It is very much applicable however if the project consists of a technology update/upgrade only, in which the business process and rules basically stay the same.
- Manually computed/defined outputs. Obviously, this may be tedious, but if there is no alternative, this will be the approach. Important is to define *WHO* will manually compute the expected outputs. Normally the best persons to do this are the end-users, so it is important to get their participation and buy-in, as this is a time consuming effort. Related to this, there are two further possibilities:

### Definition of Test Scenarios

The test scenarios will be the list of functionalities in the Requirements Section of the User Requirement Document. These functionalities are stated below:

Ref	ID	Process	Scenarios to be Tested	Pass / Fail Criteria
TS003	DS-BUR-005	Data Load	Verify that Input Files are loaded from 1am to 3am	<i>Pass Criteria</i> – Bills Presentment started the batch job for data loading between 1am and 3am
TS004	DS-BUR-006	Data Load	Verify generation of .csv file for WMS Synchronization	<i>Pass Criteria</i> – Bills Presentment generated a .csv file and dump it to the agreed folder for WMS
TS005	BG-BUR-001	Bill Generation	Verify generation of eSOA has same format as the paper based counterpart	<i>Pass Criteria</i> – Customer’s bill was generated with a look and feel of the printed bill from rovers.
TS006	BG-BUR-002	Bill Generation	Verify generation of eSOA is available for Portal Presentment and Email Presentment	<i>Pass Criteria</i> – PDF file of eSOA was generated and available thru Email and Web Portal
TS007	BG-BUR-005	Bill Generation	Verify generation of eSOA for current bill and adjusted bill	<i>Pass Criteria</i> – PDF file of eSOA for current bill and adjusted bills were generated

**Fig. 5.26** Sample test plan excerpt

- Preparation of manual test data: in which data specifically for the purpose of testing is prepared beforehand. Again, the data is designed and selected so that it covers as many scenarios as possible.
- Slice copy of production data: normally, production data is copied into the QA/Test server shortly before the testing is undertaken, guaranteeing up-to-date production data is used for the testing.
- Mock program. In which a program is created to emulate the function of the software to be tested, so that the input data is given to both in parallel and their outputs compared. This is normally done for programs that are quite critical to test, and that may have several complex rules to be tested which may be difficult to recreate manually. An example of this may be billing programs used in utilities, which have complex rules. Manual testing may not be exhaustive enough, and placing these in production with possible errors due to incomplete testing means too big a risk.

A sample test plan is shown in Fig. 5.26. Some aspects which need to be defined in the test plan include:

### Project: Bills Presentment System

Step No.	Action	Expected Results	Actual Results (w/ screen shot)	Pass / Fail
<b>Objective:</b>				
1.	Enter Username	N/A		<input type="checkbox"/> Pass <input type="checkbox"/> Fail
2.	Enter Password	N/A		<input type="checkbox"/> Pass <input type="checkbox"/> Fail
3.	Click LOG IN button	Redirect to <i>Lookup</i> Screen		<input type="checkbox"/> Pass <input type="checkbox"/> Fail
4.	Enter CAN	N/A		<input type="checkbox"/> Pass <input type="checkbox"/> Fail
5.	Click LOOKUP CUSTOMER button	Customer details will be displayed under Potential matches by.		<input type="checkbox"/> Pass <input type="checkbox"/> Fail
6.	Click View / Assist	Redirect to <i>Un-Enrolled Customer Profile Update</i> Screen		<input type="checkbox"/> Pass <input type="checkbox"/> Fail
7.	Enter Mobile Number	N/A		<input type="checkbox"/> Pass <input type="checkbox"/> Fail
8.	Enter Alternate Mobile Number, if applicable	N/A		<input type="checkbox"/> Pass <input type="checkbox"/> Fail
9.	Check "By sms" in Delivery Channel	N/A		<input type="checkbox"/> Pass <input type="checkbox"/> Fail
10.	Click Update Profile button	Message will appear: <i>Profile update successful</i>		<input type="checkbox"/> Pass <input type="checkbox"/> Fail
<b>End of Test Script</b>				

**Fig. 5.27** Sample test script excerpt

- What will be tested, in terms of modules. It should also specify what integration testing will be done, so as to guarantee that the plan is complete and exhaustive
- Who will test
- Who will prepare the test scripts/test data. It may be understood that the vendor will do this, but any participation from any other party should be explicitly stated.
- How will outputs be validated (as explained above)?
- Other relevant information (any dependencies, aspects that should be taken account, etc.)

Once the test plan is approved, this will form the basis for the test scripts. Test scripts are detailed transactional-level instructions of how the software modules are to be tested. They should be understandable by a user using the system for the first time, and so, should contain detailed step-by-step instructions, and if needed, screen shots as well.

A sample test script is shown in Fig. 5.27.

An additional type of testing is stress testing. This is used in order to simulate the handling of multiple parallel transactions by the system, which should be able to process the transactions in accordance with the design specifications' latency and throughput, or if an enhancement/upgrade to an existing system, should perform equally well as the original system. Stress testing can be done by means of a specialized stress test tool, which simulates and generates all these transactions, and reports the results. Failure in passing the stress test may be functional in nature, technical, or both.

One of the basic precepts of testing is that the test environment should be as close as possible as that which will be during actual usage (Production environment). Some common pitfalls:

- Testing is done in the QA/Test environment using user profiles which are not identical to those that will be used afterwards in actual production. A common situation here is when the testing is undertaken using a super user or administration account, which allows the user to access all modules and functions. Of course, problems due to authorization will not be apparent at this stage, but will come out once in production. Thus, the purpose of testing (flushing out issues before going live) has actually been defeated.
- Last minute changes are done in the configuration without undertaking a thorough integration testing. Typically, due to the rush, only unit testing is done, only to discover a much bigger problem later on.
- Test data. In this scenario, test data reflects an ideal world, which does not reflect the reality in terms of scope, nor in terms of data cleanliness (one must be realistic in knowing that not all data in the real environment will be clean, and this must be tested as well to see if the software handles these gracefully), nor in terms of depth (amount of scenarios).
- Test data and test scenarios used during User Acceptance Test are limited to those prepared by the vendor. Of course, if the vendor had previously tested these scenarios, they will pass the UAT! The only component that has practically changed is the persons executing them! Testing by the users has to be a combination of predefined scenarios, as well as ad-hoc situations which are thought of by the users. The more ad-hoc scenarios, the better and more complete the UAT will be.
- IT is the one to test the scenarios! This is a typical case of IT asking for trouble, as they will get the blame once the software fails. Remember, IT is not an expert in the business scenarios being tested, so it is no position to pass/fail them. Of course, it would be advantageous if IT does a first round of testing before endorsing to the users, but this is in no way a substitute for a proper UAT.
- Testers do not understand the overall process. Testers are sat in a room, given the test scripts, and asked to mechanically test each scenario. Again, this is similar to the aforementioned scenario where UAT is only using the vendor's prepared test scripts done. Because the testers do not understand the process and the system, they will be incapable of launching additional test scenarios. It is important that the overall architecture, overall business process, software and rationale for the processes are explained to the user before even delving on the test cases.

- Configurations are done directly into production! Need I say more? Well, aside from the obvious in that these configurations were not actually tested properly, there is also a very big issue in doing this, which is that both the DEV and QA/Test servers will not have these changes reflected, so these changes are essentially lost, which will also give problems to the next round of testing done in DEV and QA/Test environments because they do not reflect what has already gone into production. Of course, there are always configurations and data that may need to be applied manually, directly into the production environment (e.g. some Master Data), however, even if manually applied, they must first be manually applied in DEV, QA/test, tested thoroughly there and thereafter manually entered in PROD.
- Testing in PROD. Is there anyone out there this stupid?
- No negative testing. We spoke extensively of negative testing, failure to include negative tests are obvious.
- No rollback procedure. Not strictly part of testing, but for every release, there has to be a possible rollback. Think that the release can go wrong even if thoroughly tested.
- No thorough testing of integrations. Yes, these are some of the most difficult to test because you need to conduct transactions in both ends of the integration points. In fact, the testing should not stop at the integration interface; it has to proceed all the way to the end. This means that if system A is interfaced to system B via integration program AB, then you must first test the sequence of transactions needed to trigger the interface to system B, but continue with the subsequent transactions in system B to verify that indeed the data taken-in by system B has been correctly recorded and that system B is able to utilize this data correctly.

Test documentation is also very important, each test script must be run and verified, and in the test result portion of the test script, a proof of correctness included. This may be a screenshot, or if you believe the tester, the output result, with a pass/fail field, comment and tester's signature for the whole test script document indicating whether it actually passed or failed.

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## 5.6 Test Automation

Nowadays, new tools have emerged to facilitate in the automation of test scripts. This means that test scripts can be run by the tools, so that instead of manually entering all the inputs, these are placed in a file, from which the test scripts reads the input data, executes the different transactions, and compares the resulting output with the expected correct output (also available in a table), to mark it pass or failed. Tools of this sort have a lot of advantages, including:

- Faster test runtime
- No possible errors in interpreting results

- Automatic reports
- Easy tracking and managing of the tests
- Easy to rerun test scenarios once modification/fixes have been undertaken

Of course, one must be aware that the setting-up of these tools exacts considerable effort because:

- All transactions and processes to be tested must follow a hierarchical structure (i.e. Technical Bill of Materials) which normally has a structure software-module-submodule-process-transaction. Just defining this hierarchy, if for the first time, takes considerable effort, and making sure all the necessary details are complete for each hierarchical level as well.
- Each test scenario must be prepared, including the data and the transactions (typically, these tools will “record” your every transaction, and then have a “playback” button)
- Expected outputs must also be recorded
- The structure of the test scripts and scenarios must be planned and structured beforehand

So in fact, these tools become quite useful for transactions and modules that will be tested frequently. Frequent testing may be due to modifications done regularly or master data regularly updated. Examples of commonly changed processes are:

- Billing process in a utility company (due to the rates changing)
- Payroll (changing tax and regulations)
- Sales and Distribution processes (new sales processes and products)

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## 5.7 People Change Management

This is referred to here as “people” change management to differentiate it from ITSM change management, which is related to changes in the Configuration Items. People change management as referred to here is the process of changing people’s behavior towards an impending process and/or system change, and managing this properly so that the reaction is more positive than negative. One definition of people change management is:

Change management is an approach to transitioning [individuals](#), [teams](#), and [organizations](#) to a desired future state

As discussed in Sect. 2.2, IT is generally composed of systems, processes and people, the last component being the most difficult to manage. The reason for this is that people resist to change. Resistance is a natural defense mechanism by a person in minimizing risk to themselves. Change means the unknown, and it may mean for them (rationally or irrationally):

- More work
- More effort to learn the new processes
- No work (being laid-off)

As such, managing change is a special skill, which, depending on the complexity and impact of the project, may require full-time or near full-time dedication. Some projects have change management agents embedded in the project, and these may be:

- *Internal*: normally mid-management personnel with a good understanding of the processes to be implemented and convinced of their benefits to their organization. She becomes a “champion” in convincing others on the need for the change. In other cases, HR may be the department to champion the changes, taking up the role of change manager.
- *External*: a highly-credible specialist for that particular process. This person is normally not an IT consultant, but a domain expert familiar with industry best practices. Most importantly, he must be seen as an expert by the recipient organization, otherwise it becomes an impossible task to convince the users.

Change management is an important task that the CIO himself must partake in. In this sense, his role is primarily that of convincing higher management of the appropriateness of the change, so that management supports this endeavor (if it was not endorsed by them in the first place). Ideally, he should also find a champion within the higher management level so that the change not becomes only an IT change (which is dangerous), but a process or a business change towards a business goal.

Change management is an art, and it carries both carrot and stick components which need to be balanced depending on the situation, but no matter what the case, proper communication management is very important (see Sect. 5.1.9). As change is inherently difficult, it needs to be explained well:

- *What are the benefits of the change?* As much as possible, these should be for each (if applicable) at the corporate, department and personal levels. Eventual personal benefit will be beneficial for the employees and will result in more support for the change, while corporate and department level benefits will garner support at the mid and upper levels of management.
- *Why do we need the change?* Explain current shortcomings, or how the market is evolving such that it warrants a change in the way things are being done.
- *What does the change mean for each and every employee?* Again, the change will mean something different to each user, depending on his role in the process, so that the message needs to be changed depending on the audience. Implementation of a new Enterprise Asset Management system means something different (and different tasks) to the maintenance engineer as compared to the plant manager, or to the finance department in charge of assets.
- *When and how will the change take effect?*

- *Elicit the support that you need from the users.* Be as concrete as possible in what you need from them, such as approval of process documents on time, sufficient dedication to testing activities, volunteers for Trainor's' training, etc.

Change management is usually one of the most difficult tasks in making projects succeed, and requires very special skills. Communication may be maximized via a variety of channels; the idea in general is to build-up the tempo until the go-live date:

- Presentations to the higher management. This should explain the points above: benefits, reason for the change, what the change means, and very important, one must be honest at to the possible difficulties and risks in applying the change, so as not to build false expectations. It is of no use as well to overstate the expected benefits, if these cannot realistically be met.
- Email blasts announcing the project and what this means for the employees
- Announcements and specials in the company's internal newsletter and/or magazine, explaining in laymen's terms the project.
- Banners, leaflets and other materials
- Special feature in the company's portal
- Workshops in which management and key users are invited to present and discuss with a more general users' audience the implication of the project.
- Roadshows in which IT and other key departments reach out to the users by going to them

The manner in which change management is to be conducted depends to a large extent on the culture of the company, the maturity and profile of the users, as well as the credibility that IT has in the eyes of the users.

Typical challenges faced by the change management team include:

- *Little kingdoms.* Sometimes, certain departments do not want to share data or prefer to stay opaque so that their internal inefficiencies cannot be seen by others. The remedy to this situation is to force it open by means of the mandate handed down by senior management; there is usually no way to convince these middle managers by just discussing.
- *Non-standardization.* Related to the first, processes may be differing in different geographic locations even if under the same department, for the mere reason that no implementation was previously done to standardize. In this case, users and managers may want to keep their old process merely due to familiarity. In some cases, they may be willing to change but the challenge here will be to get all the different units to agree to a common process. In this case, it becomes necessary to explain and have the necessary patience to get the buy-in of the users for the new process; however, if things get nowhere, it may be necessary to invoke senior management or the steering committee's direction and push.
- *Adherence to their known process (inertia).* This will also require time and effort in explaining the new process and its benefits. Buy-in from key users is essential

for the project to succeed, as imposition may result in a backlash when things divert from the ideal.

- *Wanting too much.* This is the opposite of the former, in which the users, having attended some seminars and workshops, want to implement a super-perfect process which may be unreasonable or impossible to implement at this moment in time due to the complexity, company culture, budget, etc. This again requires careful management of expectations and explanation to the key users. Part of the explanation may be to indicate how much complexity, risk and cost this would entail, and a compromise may be to delay to a later phase, which will then be evaluated.
- *Users changing their mind.* This is very risky, as accepting this, even if a small change, may lead to further changes down the road, leading to project creep. One must weigh whether such changes are indeed warranted, and as a general rule changes should be discouraged as they introduce additional cost, risk and delay to a project. A possible compromise can be to evaluate these requests for a later phase (if possible and feasible) after the go-live.
- *Senior management changing its mind.* This is very difficult to manage indeed. Most that can be done is to properly inform management on the implication of this change in terms of time, risk and cost. A possible protection may be (if the request is only from one particular executive) to escalate this to the steering committee for decision.
- *Fear of getting fired.* If this is unjustified, this should be explained as such. If justified, then HR has a special role in ameliorating the situation by having designed the severance package for those affected, or having identified where personnel will be reallocated. This must have been discussed very early during the project, flagging HR on the possibility of such a downsizing resulting from the process change. In a highly unionized environment, a heads up must be given to the union so that they will not oppose and sabotage the project.
- *Fear of being irrelevant.* This again may be founded or unfounded. Oftentimes however, there is a misconception that when the process comes in and makes things more efficient, their clerical work now is not needed and they become irrelevant to the organization. It may be unfounded because their previous role, though not existing in the new process, may be replaced by a more sophisticated and analytical one. Of course, this may not be true for all, but sometimes the fear of change is so strong that even people that should not be wary of the change are swept by this sentiment. This may even be true for IT personnel, wherein the implementation of a new ERP system in place of the custom developed in-house application is seen by the old programmers as a threat to their existence, as they think that the new application will do everything they have been doing before. Again, this takes careful coordination with HR, and also assistance in leveling-up and skilling-up so that personnel can take on new roles.
- *Fear of losing power.* This is again similar to the “little kingdoms” syndrome explained above and again is usually non-negotiable as users bearing this attitude will usually not be convinced no matter what, so there is no choice but to impose.

- *IT has no credibility.* “Here we go again. . .”, “What did IT cook-up this time. . .”, and “Oh no, another one of this useless IT projects...” may be some of the comments heard. In this case, the IT organization has a serious credibility problem which will not be addressed by dialogue nor imposition using senior management’s support. If the project is quite complex, it should not have started in the first place, but rather, it should have been postponed until such time that IT has enough credibility to succeed in the project. It may need to start with smaller projects and smaller wins before attempting the big one. This of course may not always be possible, take for example a new CIO given the task to push through with this big project. In such a case, he needs to ensure during the course of the project that things are running smoothly and not out of hand so that his credibility is enhanced during the project. He needs to get more involved in the project than usual.
- *Fear of technology.* Let’s face it, some people, and especially the older generation, may fear technology. Because they do not know how to use it, they may reject it altogether. Within this group however, there are those that can learn, but also those in which trying to learn becomes an altogether useless endeavor. The ideal scenario here is to retrain the first and lay-off the second. Again, the particularities of the organization will dictate if this is at all possible.

Senior management may also have expectations of reducing the headcount of the company by means of the project, so this necessitates heavy HR involvement in identifying the people affected, designing the retirement package, as well as communicating this properly to the employees. Redundancy should not be hid from the employees, but should also not be emphasized (unless of course, many of the affected employees have in fact a desire to leave the company). It will form part of the discussion on how job positions and roles will be affected.

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## Cut-over into Operations

# 6

*Cut-over here refers to the transition of a project into operations. Not much has been written about this very critical phase, which usually causes a lot of disruption to the business. It is a difficult phase because it is when normally two distinct and disjoint teams have to work together in transferring an asset from one to the other (project into operations).*

*The first and foremost premise for a smooth cut-over is to involve operations in aspects which they will later on be in charge of maintaining: technical architecture, functional design and its maintenance, as well as tasks in which they themselves will be involved in during the project itself such as developing interfaces or data migration. It is also important for operations to have a full understanding on the grand vision of the application itself early on, and to understand the details (process, code, permissions) as the go-live date nears.*

*From the point of view of the project team, several aspects particular to cut-over need to be addressed. Firstly is the awareness of the users to the upcoming go-live, which may significantly affect the manner in which they work.*

*Other important aspects that need to be coordinated early on with Operations are their particular guidelines, the environments that will be used (DEV, QA) and who will be responsible for releases in/from each, backup and restore procedures, security, as well as escalation procedures.*

*Data migration and data quality are interrelated and depending on the project, may carry a heavy amount of work that need not be belittled, and should be thought of early during the project. Data quality cannot be usually decided upon by neither the project nor the operations team and is the realm of the end-users, it is only they that have the capability to validate the data, and therefore, is their responsibility to clean it, which should be done in preparation for the data migration and go-live. A related aspect is that upon going live, some data may not or cannot be migrated and should be manually recreated into the new system, this again requires end-user participation and should be managed early during the project.*

*Lastly, success of the project upon going live depends greatly as well on the ability to resolve incidences as they are being reported by the end-users. Crucial to*

*this success is a clear delineation of who is to conduct 1st, 2nd, and even 3rd level support, as well as the escalation procedure process.*

One of the most crucial, risky, and yet an unavoidable stage is when projects are turned-over to operations. Oftentimes, the team(s) handling the project is not the same as those handling operations (and is not even recommended), even if the IT project in question may be using a technology that is currently supported by the O&M team. In many cases, the team handling the project has been contracted from outside the organization, or may be a mix of in-house and contracted resources. Cut-over is crucial, as a proper hand-over guarantees long-term success of the project, as well as its proper long-term support, and yet is risky simply because the team handling the operations has not till this moment been exposed to the project, sometimes to the technology, and most probably also have little knowledge of the processes that are being implemented.

It has been my experience that even for applications where the O&M team is familiar with the application itself, a major change of business process may throw the O&M team in disarray as they are still thinking of the old processes that were in place.

As a real-world example, we implemented a reconfiguration of an ERP to introduce a different materials ordering and reservations process in the central warehouse. Previously the materials were ordered and reserved by the different respective divisions until their full consumption by the division that ordered them. This resulted in inefficiencies when a different division would require the same materials but would not be able to withdraw as the materials were already reserved by the former division even if not consumed immediately, resulting in an additional reordering and delay in the delivery of these additional materials. We decided to do away with this by centralizing materials into a “pool” anyone could request withdrawals from, even if they were not the division that had originally ordered, resulting in lesser idle inventory, increase availability and less delays. It was however not enough to have the O&M team (and the users for that matter) understand how to transact, this was a major change in the way the whole ordering and inventory philosophy was redesigned, and it was crucial that all the teams understand the differences, so not only did they train on the transactions, sufficient time was given to explain the overall philosophy and process, so that whenever an incidence would occur, they would have the capability to analyze and diagnose what the root cause could possibly be.

Needless to say, the earlier the O&M team is updated and is familiarized with the project, the better. The amount of details that the O&M team should be given however shall depend on where the project is at that moment in time:

- **Kick-off/inception**—if the project is closely interfaced or involves modifications or enhancements to existing systems and processes, it pays to involve the O&M team early and discuss the overall philosophy, architecture, and processes that the project will embody. The O&M team is in the best position to analyze, criticize and give suggestions. This will also make them aware of when the project will come on-line, as well as what shall be expected of them (for example, if the O&M team is to develop new interfaces to systems currently in production), and at what point in time.
- **Architecting phase**—the Technical Management team should be involved here as the project shall need servers, storage, network and other infrastructure requirements. The technical team should generally provision these and the corresponding environments (DEV, QA, Training, and Production). It is imperative that the technical team understand the requirements and suggest on best options (e.g. have a separate QA environment from the existing QA being used in operations, have a separate training environment from QA). Some specific items which will be further discussed should be taken-up during this stage:
  - Approval of the overall architecture
  - Approval of the different environments
  - Backup and restore procedures
  - Release management procedures (also with the application Management team)
  - Password change management: how?

To cite some other practical examples on the importance of having approval for the overall architecture let me refer to two projects. The first project involved the delivery of a Datawarehouse solution with several software components. The project team assumed that all these different components (ETL, front-end tools) would be installed in the same server, however, this was not the software vendor's recommendation and it resulted in very poor performance of the servers. This meant that a whole reinstallation had to be done, even after the project had started and already carried several configuration changes in the platform, which obviously had to be repeated manually, causing a significant delay in the project.

My other example is with regards to security. Nowadays mobility and internet access of applications is pervasive. When we implemented a new customer-relationship application on the internet, we reviewed the different software components that had to be installed, the servers they would reside on, as well as the connectivity and network Access Control rules between all these components. Because internet-facing applications need to retrieve data from the back-end which is in a secure area (intranet), this would need to be done in a secure manner. Internet-facing applications would reside in the DMZ while leaving no loopholes in terms of possible breaches in security and confidentiality to the backend. A risk review on possible

(continued)

security breach scenarios needs also to be conducted as there is no way to guarantee 100% that security breaches would never occur.

In both cases an early review and sign-off of the architecture is crucial in avoiding issues and delays.

- **Hand-over preparation**—as the go-live date comes near, the O&M team should be prepared by giving them more specific details on the project. This has to be timed correctly, giving details and training too early will mean that the team will forget once the actual go-live date approaches, too late and they may not have enough time to understand completely, or as it happens many times, the project team is too busy with the go-live preparations and fire-fighting activities to dedicate sufficient effort to this. Specific aspects need to be discussed during these sessions:
  - **Solution overview**—involving TM, AM, ITOM, SD. Here is the discussion of the objectives of the project, general architecture, the processes involved, end-user departments involved, and leaves the floor open to the different teams for Q&A. It is important to note their inputs, as they may be very valuable in avoiding issues down the road.
  - **Process discussion**—mainly for AM’s benefit, is an in-depth discussion of the processes captured by the system, usually described in detail by the blueprints and functional requirement documents. This is a more detailed version of the solution overview but going into the details of the process that AM would care about. How does the new process fit in with the legacy? Are there modifications that need to be done in the current process? Will resources be needed by O&M for this?

As an example, when we implemented the updated Automatic Debit Agreement process for automatic payment of customer bills from their bank account, there were tweaks that were needed in the way the payment allocations were done to the accounts. The default process is allocating the full payment to the oldest outstanding amount, but this was found to be problematic as some arrears were historical and had to be written off, and customers advised of the fact before the allocation rules could be applied automatically. Otherwise, the customer might get surprised to find his bank account deducted with a tremendously huge amount!

- **IT Operations**—once the system is turned-over, this will describe any day-to-day operations that will be handled by ITOM group. This usually includes data maintenance and clean-up activities, report generation, batch processes that need to be scheduled and run, error detection analyses, etc.

As an example of this, the ITOM would be in charge of the daily generation of reports. Though the reports may be scheduled, they would still be monitoring the batch processes for proper completion, in some cases validating the outputs with the users before officiating the reports (for example, finance personnel giving its go-signal on financial reports before release due to possible last

minute reversals or adjustments that may have not been captured), as well as identifying the reasons for discrepancies in the generation of the reports.

– **Technical discussion with TM:**

- Final backup and restore procedures
- Pre and post-go live tasks that will be performed
- Final Password change management procedure
- Release Management (also with the AM team)

– **Frequently Asked Questions (FAQ)**—for the benefit of SD, questions that may be raised by the users to enable the SD to immediately reply without having to escalate the ticket. The more comprehensive their understanding of the system and the FAQs, the more tickets that will be resolved under a First Call Resolution (FCR). Imagine a change in the configuration to access internet within a company in which the proxy is now disabled and goes to internet directly. If for some reason this change has not taken effect in an endpoint, the user will not be able to access the internet. Rather than SD escalating this ticket to TM for investigation, best is if they have sufficient information to:

- Determine if the proxy is still enabled in the endpoint's route (open your browser settings, check internet options, . . .)
- If still enabled, the step-by-step instructions on how to disable it
- Procedure on how to confirm that the issue has been resolved (please restart your browser; try to connect to this site. . .)

– **Configuration Management**—this is for the benefit of the AM group, and will teach the team how the system is configured, meaning of the different configuration parameters, so that the team will be able to support and maintain the new application once requests or incidences are raised by the users.

This particular training is quite detailed and technical, as well as easily forgotten unless put into practice shortly after the training. In my experience, we have even had to conduct several repeat sessions for O&M for them to actually get a good grasp of what it entails (but is time well-spent). It is always complemented by the configuration manual, reference manuals, as well as training slides which can be returned to for reference.

– **Program Code**—this will be turned over to both AM's business Analysts and programmers that will be in charge of subsequent support. Needless to say, the programs must be properly documented according to the receiving organization's standards, and the program coded as well using its standards.

– **User Acceptance Testing (UAT)**—end-users should ideally be involved during the User Acceptance Testing; in fact, the best users are those that will actually be transacting with the new system. It is also recommended that O&M either participate in the testing, or at least observe the testing so as to familiarize itself.

A common pitfall here is that although the end-users test, it is not the proper end-users that do so. Sometimes this may be due to the real knowledgeable user not wanting to dedicate time, other times this is because due to the change in process, roles inside the organization change but is not apparent to the end-user departments.

- **End-user training (EUT)**—similar to UAT, the people trained will be those to actually use the systems, but it is also recommended that O&M be part of the training, or at least be involved and present during these for familiarity’s sake.
- **End-user awareness campaigns**—the project may be perfect, but if it fails to generate acceptance by the users, it will ultimately fail. This of course cannot be addressed only during the cut-over period, users must have been involved from the very onset of the project (see earlier change management section), but of course, not all end-users can be involved, especially if it involves a large number of users. Depending on the breadth and importance of the project, it may be important to drum-up awareness and support for the project, this can be done through several means, such as:

Getting the buy-in from top executives: they can in turn be your best “salesmen”

Awareness posters, brochures, T-shirts, and information campaigns.

Awareness Workshops

Publishing information in the company magazine and portal

Roadshows, if users are in dispersed geographical locations

- **Agreement on 1st, 2nd level support:** one of the most difficult decisions to make is how and who will render 1st level support upon going live. Right after going live, the number of project-related incidences shall jump, and it is of course preferred that these be acted upon as soon as possible. The tendency therefore is usually to assign the project team to be the one to render 1st level support until the warranty expires. The danger to this is that once the warranty period expires and the O&M team takes over, they are basically neophytes in handling the system. The warranty period is also the best time to learn on how the system is configured, familiarize oneself with its processes and learn how to troubleshoot. By taking over after the warranty period, there has been little adjustment and learning time, even if the O&M team was tasked to observe during this period. The trade-off is further discussed in the next sections, but what is important to mention at this point is that there has to be a formal agreement on how 1st level and 2nd level support will be undertaken, the exact process (of how tickets will be escalated, closed, etc.) and who will be in charge of what.
- **Go-live**—this is the moment of truth, the next few days and weeks will oftentimes define the success or failure of the project, depending on the users’ acceptance, the ability to address incidence tickets coming in, and fix these in a timely manner.
- **Post-go-live**—it is imperative during this crucial period that tickets be closely monitored. Incidence tickets should be given primary importance, and the root-cause of the incidences identified. As such, incidences with a common root cause should be grouped, and depending on the urgency and severity, be prioritized for fixing.

In the next sections we explain in detail some of the specifics of how a proper cut-over should be done.

## 6.1 Backup and Restore Procedures

This seems self-evident. For any application and system, a backup and restore procedure should be in place. The reason why I mention this explicitly is that there is no unique way of conducting backup and restore. It not only depends on the application, it also depends on the DB, the infrastructure used, as well as the type of backup, and what one wants to backup. Same goes for restoration.

And so, the worst situation possible is that you are ready to go-live, but before you do that, you wish to back up your QA and Production environments in case something goes wrong, only to find out that you do not have complete, detailed information on how this is to be done correctly. The project team will have its particular opinion on how backup and restore should be done and TM will have its own idea. It is important therefore that early in the project (during the architecting phase, which comes very early on), both teams have an agreement on how this shall actually be done. Actual execution however should be undertaken by the TM team.

Important aspects to take into account are: (wherever it says backup, restore also applies here)

- Full back up or partial?
- How to backup specific portions of the system, for example, only the configuration, only the data. For the configuration, what are the different configuration files and what are their functions?
- How to make a fast backup (for example, a dump to disk)
- When to do which type of backup
- How do you know if backup completed successfully
- The detailed instructions on all of the above (this can be agreed upon before going live), including pre-backup and post-restore configurations that may need to be executed.

If possible, an actual backup and restore procedure should also be conducted for test purposes.

A typical mishap scenario here is that the backup and restore procedures are incomplete. Take an example in which the configuration is to be backed-up separately from the data for purpose of releases. This means that the backup is done not just by copying an image or dumping the entire contents of a server into a tape, but exporting a configuration file from the application and copying that into the backup media. It may be that the application has several configuration files that need to be backed up, so that if one is forgotten, the recovery will be incomplete. It is also for this reason that a simulated recovery is always recommended as it ensures that nothing is forgotten.

## 6.2 Release Management Procedures

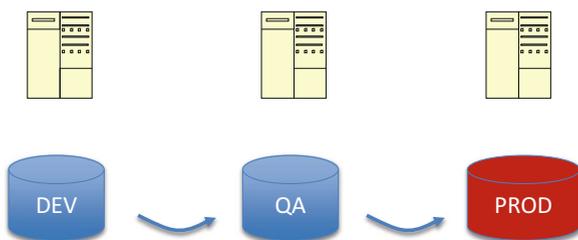
As discussed in the previous chapters, release management refers to the procedures on how a change that is made (normally starting in the development environment), is to be replicated into the QA/Testing environments, and subsequently to the Production environments. Release management procedures refer to the manner, the control and authorizations around the release (Fig. 6.1).

In its most primitive form, release management is done manually, meaning, that a change (in the configuration, for example) is then replicated manually in the subsequent environments by undertaking the same tasks as what was done in the DEV environment. This, of course, is the *most primitive form*, and should be avoided and not used if the application has a better way to undertake release management. The reason why this method is not preferred is that it is error-prone, a change undertaken in Development may not be fully reflected in the subsequent environments, resulting in discrepancies between environments, possible errors or incidences which may take time to troubleshoot.

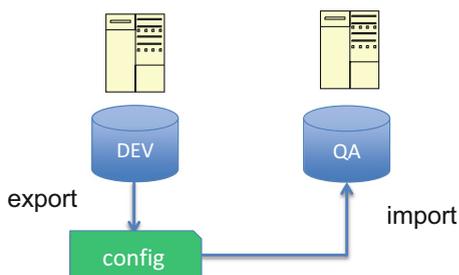
Other manners in which release management procedures are typically undertaken are through export-import of configurations, in which the configuration is first exported to a file, this is then copied to the next environment (say QA) and then imported, taking effect in the new environment. This is shown in Fig. 6.2.

It is only the configuration that should be exported and imported; as otherwise, the procedure is not feasible because production data (once released to the production environment) is overwritten, same concern as for the QA and testing environment.

**Fig. 6.1** Common release lifecycle



**Fig. 6.2** Release by means of copying a configuration file



For some other systems release management is highly automated and efficient, having been given due attention. As an example, SAP ECC has its so-called transport procedure, which allows not only the whole configuration, but specific configurations to be released, and can easily be reversed. This may also include authorizations and user profiles.

Some aspects of release management which need to be taken into account are:

- **Scope of the configuration which is to be released.** Should describe first in layman's terms what the configuration is, and then give the technical details on it for an AM team member to understand.
- **Traceability of the release.** The release should be traceable from the beginning of its journey (from DEV into QA and then to PROD), there may be an identifier (key), a ticket number, or both to be able to trace it. It is important for TM, which conducts the release to be able to verify that the proper release procedure is being followed.
- **Cancellation and reversal procedures should be clear.** In the worst case, this can be a restore from backup procedure (worst because it is usually the most lengthy to execute), in some applications, there is a release management system which allows you to roll-back the release.
- **Whether releases can be made while the system is live.** More advanced applications allow this, however, for those that need to import-export the configuration files, this is generally not the case, and the system will require downtime.
- **Freeze.** Even if the system is live, are there transactions that require a "freeze", meaning, that they cannot be executed. This can be done by locking the transactions or locking out the users. The reason for the freeze is that the release will affect these transactions, and therefore will create a conflict if the release is done simultaneously with the affected transactions.
- **Order of the releases.** If the application allows for live releases, this means that the configurations are released piece meal, so that if there is a lot of changes that need to be released, these will come in batches, and oftentimes, this batch of releases has a relative sequence, so that one release cannot be done before the other. This should be taken into account and explained correctly in the ticket.
- **Roles of different Operations teams in the release management:** ideally, request for release will be done by AM, execution done by TM.

In my experience as CIO, I have come across multiple bad practices from vendors:

- Configuration changes made directly into production: this is the worst possible practice; it results in very different configurations in PROD, DEV and QA which are now hard to trace and reproduce back into DEV and QA, and need to be recreated manually. This is also a common reason why some IT departments require many personnel, because they are the "experts" in knowing what changes have been made to the production server while failing to document it, so that the

organization becomes overly dependent on their knowledge, and unfortunately, bad practices, while they continuously configure things in Production.

- Development and/or configuration changes done directly in QA. In this case DEV is not in sync with the changes in QA and PROD and when the next releases are made from DEV to QA and PROD, there is a chance that the changes become undone. This results in a lot of analysis and troubleshooting to detect what went wrong.
- Testing in DEV. DEV is a machine without practically any data (so not much to test), and with insufficient resources to conduct a thorough testing, which typically consumes a lot of resources and would require a bigger machine.
- QA environment not in-sync with PROD. This means that even if a test passes in QA, it may still fail in PROD.
- QA data is very old, so that testing in QA passes but not when the actual data in PROD is encountered. This can be addressed by refreshing QA data with the latest PROD data.
- Insufficient testing (in QA), so that the errors come out when released to PROD!
- Testing in PROD! You will overwrite valid transactional data with garbage test data!

Special mention should be made on:

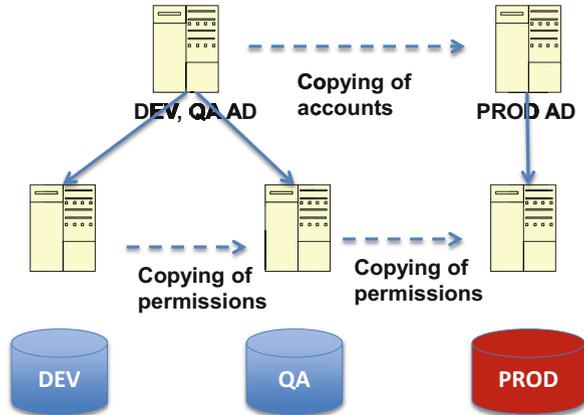
- **Roles and permissions:** Should be the same across all environments as explained under testing. Thus, it is best that roles and permissions be made part of a release across all environments (also originating in DEV).
- **Active Directory and LDAP:** If the application is using LDAP and/or Active Directory in which a single sign-on is used, then it is also recommended that the actual LDAP/AD accounts for production also be defined during testing. This can be achieved by having a DEV/QA/Test AD server specific for the DEV, QA and Test environments. In this case, the rights and permissions in the AD flow from DEV into QA and PROD AD as well, guaranteeing that all environments are using the same account names, and guaranteeing that the testing will be undertaken under realistic conditions and permissions. This is illustrated in Fig. 6.3.

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### 6.3 Business Process

As mentioned before, it is imperative that the O&M team understand the underlying processes of the new system. Understanding purely technical aspects of the solution is not enough. Business Process helps the team to understand the way things work, their rationales, how they are being undertaken by the system, and importantly, why they are being done in such manner. This will help during analysis and troubleshooting, since O&M is able to grasp the intended outcome. For this purpose, the blueprints, functional design documents that were developed and finalized

**Fig. 6.3** Managing Active Directory accounts



during the analysis and design phase of the project are commonly used, and are then explained by the project team during a sit-down interactive session with O&M.

## 6.4 Data Migration

Another commonly underestimated task refers to that of data migration. This refers to the process of importing into the new system, data that either resides in a legacy system that will now be supplanted, or in different sources which now need to be consolidated and uploaded into the new system. A data migration plan must be prepared well before the go-live date as part of the cut-over, and depending on the amount and complexity of the data, could range from a few weeks to months prior to the actual go-live. Data migration itself, if complex, may need its own plan, with its own go-live dates and milestones, which need not necessarily, coincide with the system go-live. For example;

- Data may be migrated only shortly before going live; or
- The data may be too voluminous and complex to risk being uploaded only shortly before going live, so that a partial upload may be conducted for testing purposes well before the date

The source data may also vary:

- Source data may be static or semi-static, in such case, a single upload shortly before the go-live may be sufficient or if not, a big time upload with a subsequent update will suffice; or
- Source data may come from another transactional system which changes every day, hour, etc... As such, the data migration needs to be carefully thought-out as the final data must reflect the complete source data for there not to be incongruences. In this case, a “freeze” period may need to be defined for the source transactional

system, in which no new data is created while the final migration is taking place. Depending on the system (e.g. sales system), this may not be acceptable, so that the migration shall necessarily have to take place during a narrow window when no transactions take place, for example, during a weekend.

This brings me to the point that a data migration plan needs to be formulated well in advance so as to minimize mishaps! The plan may start as a very high-level document detailing the general philosophy of how the data is planned to be migrated, milestones, QA, etc. In general, it should contain:

- A general plan and tasks set forth for doing the migration. If a calendar can be defined, so much the better
- Dependencies for the tasks
- HOW the data is to be migrated. This may take the form of extraction programs, upload programs or tools that will be used for this purpose. Take note that some of these programs and tools will have to be developed/conducted by the O&M team as it involves current systems in production, so their early involvement and understanding is crucial.
- Quality Assurance. How will the data be tested for correctness, basis for correctness, as well as the acceptable pass/fail criteria

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## 6.5 Cut-Over of Transactions and Data Quality

Transaction cut-over may mean many things depending on the context. If a legacy system is to be replaced with a new system, it refers to all the procedures associated in ceasing to transact with the legacy system and having to transact with the new system. For systems that are being reconfigured while in use, it means having to deal with a new configuration which may not work with the legacy data, configuration and setup. In both cases, there are a number of tasks that need to be done, and many of these are not IT's responsibility but the end-users'. In spite of this, it is IT's responsibility to identify all these tasks, disseminate to the end-users, conduct proper training and awareness, and monitor these before and after going live to ensure the new system encounters minimal hitches. This is of course simpler said than done, as many times it is hard for the users to fully grasp the implication of these procedures, and may be time consuming for them to perform.

Some examples of cut-over tasks are:

- In implementing a new General Ledger chart of accounts, data should be mapped from the old GL to the new GL, these may be limited to end/beginning balances, however, the new account structure may

(continued)

necessitate that a mapping and re-computation of these be done so as to know which accounts are to be transferred to the new GL using what rules.

- New billing system. Similarly, a mapping for each customer's billing details needs to be done and data from the old system mapped to the new one. Questions will arise such as what level of detail should be carried over and in what specific fields should these be loaded. As the new billing system will work with different business rules vs. the legacy, it is unrealistic to expect that all fields will map seamlessly, so that a decision must likewise be made where and if to store certain information. For example, storing details on an installment plan that is being phased out.

As a practical experience to share, we implemented a new billing system in a large utility company, however, the management of the utility company did not entirely trust the new billing system, so that they required that both the old and the new system run in parallel and all discrepancies be cross-checked. Needless to say, this was a very tiring and expensive exercise because as expected, many of the bills did not match, not because of errors, but because of data being processed differently and, because they did not have the same business process (otherwise, why replace?). It would have been much more efficient to test thoroughly the new system and, for the remaining errors that would still show, have a team analyze these and tweak the system accordingly. This parallel run was eventually dropped a few months after as management realized its futility.

- A new purchasing and inventory system. As purchases and deliveries cannot be stopped due to the continuous nature of the business, a conscious strategy must be thought-out on how to handle transactions that spill over from the old system up to the new one. As an example, take a purchase order that was released by the old system, and in which the goods have not yet been delivered (received). How these will be accepted by the new system needs to be clear, including:
  - Should the Purchase Requests and Purchase Orders be recreated in the new system? How will these be traced to the old system?
  - Is there a budget implication? If these transactions referred to the old budget, should the budget now be adjusted accordingly?
  - What information needs to be disseminated to the suppliers? (I.e. reference new PO number that supersedes old, etc.)
  - Should an inventory count be done shortly before going live to make sure system stock reflects actual? Should there be a materials withdrawal freeze?
  - For withdrawals from warehouse, how are these tracked while the system is down due to migration to the new system? If manually recorded, how will these be reentered into the new system once it is up?

The list of activities will vary according to the type of project and specific situation on-hand. As much as possible, data that can be migrated using special scripts and loading programs should be utilized so as to minimize manual intervention. These programs' mapping rules should be done in accordance with the users' inputs, the users that own the data. It is apparent from the above, however, that migrating ALL data automatically will be impossible, and that some transactions will need to be undertaken manually in preparation for the go-live, as well as during post-go live. These must be carefully identified, and the correct procedures for conducting them discussed and finalized with the users. It is important to involve the users early so that they understand the need for the procedures, have a buy-in, and subsequently commit to undertaking their part of the tasks. Failure to do so may be disastrous, so that when things go wrong upon go-live, all the blame goes back to IT. If for whatever reason commitment from the users cannot be obtained, an analysis should be made on whether to postpone the go-live, and in any case, the situation should be escalated to higher management (typically the steering committee) so as to get their support, and subsequently, that from the line units.

All of this discussion in the end falls into the general category of data quality. No matter how good a system and its designed processes are, if the data is dirty, inaccurate or obsolete, the system will fail to deliver its function, and it is much less expensive to address data issues before implementation, rather than afterwards. Inventory systems with inaccurate inventory counts, billing systems with billing errors and reports with unreliable information are examples of such failures which no IT manager wishes to encounter, and yet, are all too common.

As an example of dirty data, and how it needs to be corrected, we implemented a new self-service HR application which did away with all the manual, emailed-based and paper-based processes for viewing pay slips, requesting for leaves, requesting for loans, overtimes, etc. The employee would now go to a self-service portal and have access to all these or initiate the request electronically. As such, it is essential that for the system to work correctly, the data should be clean. For example, data on who is the person's next approver should be correct, otherwise the request for approval (for a leave, for example) would be routed to the wrong person. As the information came from paper and was put into the system, it was expected that such errors would occur, which they did, and were corrected after the system went live. Take note that in this case HR's participation is essential for this clean-up to happen as IT has no knowledge whatsoever on the correct employee-approver relationship.

Nowadays, the relevance of Data Governance and Data Quality has taken new importance and new meaning, especially in the light of the mishaps that have occurred in the financial industry during the financial meltdown. Financial institutions failed (or did not want) to understand their own data in terms of products they were offering, and their relationship to the liabilities they would face if a sudden reversal of fortunes in the economy would happen. The "off-the-books" attitude they

took in creating these new financial instruments basically hindered them in fully understanding the data underneath these products, its customers, the loans they were collateralizing, and most especially, the underlying risk exposure. For this reason, regulators have to come down hard on the industry and new ways of addressing data quality have taken renewed interest. Although this topic is way beyond the scope of this book, there is a bit that can be said with regards to data migration and data quality.

As an example, we developed a new set of comprehensive reports to conduct geographic and demographic analysis of our customers, however, when the address information was utilized, it became apparent that this information was “dirty” such that the address field which was a free-form field containing inaccuracies, inconsistencies and omissions. We therefore embarked on an address-cleansing project which entailed structuring the address information in a standard, structured manner:

Region-Municipality-District-Subdistrict-Street-House#-Block-Apartment-Door

This posed a major challenge because unlike in other countries, addresses in the Philippines do not follow a usual pattern. However, this was a necessary step in getting correct analysis reports. Cleansing also does not stop at cut-over, but is a continuous process.

In another example for a hotel, we found out that many of the essential data on the customer were left blank by the front-office personnel as they would hurriedly check-in the customer by merely pressing <enter> or entering dummy data into the front-desk system for many of the required fields, in order to advance fast.

Data correctness is always easier to implement at the point of capture, and much more difficult to correct afterwards, as many of the banks are now realizing when dealing with “Know your client” and Anti-Money Laundering laws that are being enforced globally.

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## 6.6 Interfaces

Interfaces are a common source of errors and malfunctions as these are commonly custom-developed in accordance with project-specific requirements, the systems being interfaced, as well as the data flow requirements between the systems. As with all custom-developed programs, these are usually the pieces that need most testing, and will commonly have some malfunctions slip through undetected. Due to this, interfaces need to be especially thoroughly tested. A test plan (see Sect. 5.5) should have been established first to make sure that the whole interface process is taken into account in the testing, and not only itself in isolation. This means the whole process from when the data is prepared in the source system, sent through the

interface, accepted by the recipient system, and then consequently processed by the recipient system to produce the corresponding expected results. It must be emphasized that the testing should encompass the *whole process* from end-to-end. If just the interface program itself is tested, there is no assurance that it will actually give the expected results.

Some other special considerations when testing interfaces:

1. **Completeness of test data**—the interface must be tested under different data scenarios.
2. **Negative testing**—testing for data scenarios in which the interface should not proceed. Negative testing should always form part of any test scenario, but is especially important in an interface.
3. **Log errors**—if an error occurs, this must be properly reported and logged so as to be able for the O&M team to debug. One must always assume that some failure will occur in the interface at one time or another, so it is important that this be detected and that enough information is given so that it can be traced. Errors may be due to unacceptable data ranges, wrong data format/type, one of the systems not be ready for the data transmission/reception, etc. The more explicit and more information logs give, the easier it shall be to debug later on.
4. **Invalid data transmission**—it may be that the interface worked correctly and data was transmitted to the recipient system, however, the data as received by the recipient system may be in inappropriate format for it to be meaningful, so that the recipient system cannot continue processing it. Proper testing would minimize such situations; however, it is again impossible to assume 0% probability of this happening. As such, proper messaging and logs need to be produced by the interface (and related) programs, so if and when such situations occur, they can easily be detected and traced.
5. **Error-handling procedures**—again, it is important to assume that errors will occur, and so the interface must have had an error-handling procedure defined, so in case it happens, there is a clear operational procedure (not a project procedure) in terms of what should be done. If say, for example, the recipient system continuously accepts erroneous data, there must be a clear way to identify the problematic data, as well as a contingency plan on what to do with it. Failure to have come up with such procedures may affect operations permanently or for an extended duration of time, as there may be no way to identify the erroneous data, nor a clear way to clean it up.

Needless to say, interfaces should as much as possible use or be based on standard available interfaces. For SAP systems for example, these would be the BAPIs which can be further modified or embedded in other code. Use of standard interfaces minimizes customizations, as it means reusing previously tested interfaces.

A particular experience we undertook was in interfacing a CRM system with the back-end customer billing system. The interface was designed to take into account the process needed for when a new customer would open an account. This was triggered in the CRM and would send the details to the Customer billing system for the creation and setup of his entire account structure, including the initial payment for opening the account. This was tested and worked correctly, however, it was tested only up to the point of account creation in the billing system, but the billing system was not run for a complete cycle. It turned out that although all the details and account structure seemed correct, upon running the billing system, receivables were created where they should not have, an oversight in terms of not having conducted a complete end-to-end testing of the new process, for even if the billing system was legacy, the process was new and should have been completely tested.

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## 6.7 Support Strategies and Structures

As mentioned during the introductory section of this chapter, there is a need to clearly define support roles and responsibilities. Generally-speaking there are a maximum of four entities types involved:

- O&M Team—in charge of supporting the operation and maintenance of systems in production
- Project Team—in charge of the delivery of the new project being put into production
- Product support team 1st level—may or may not be part of the project team. May be part of a formal support team supporting all deployments of the product, and may be handled by the product reseller/distributor or the principal (product owner) itself.
- Product support team 2nd level—if the 1st level product support is handled by a reseller/distributor, then normally, a further support level is handled by the product owner itself, for tickets that cannot be resolved by the 1st level.

However, the above does not describe clearly the delineation of responsibilities for each team during a project. It is indispensable to define these before going-live and preferably during the start of the project, as this may have contractual and monetary implications. If responsibilities for ticket handling and escalation are not clear, this may cause undue delay in the processing of tickets. Ticket escalation and handling may be a policy dictated company-wide or specific per project, and as explained in the introduction, requires careful thinking due to the trade-off between quick response time and the essential knowledge transfer from the project team to the O&M team. Table 6.1 is an example of a typical support matrix that can be utilized.

**Table 6.1** Sample support structure

		Unit handling the support level			
	What it is	Project before going live	Week 1–2 after going live	Project Warranty period <sup>a</sup>	Thereafter (covered by annual license maintenance)
1st level support	First to receive and handle incident tickets (after service desk)	Project team	Project team, shadowed by Operations team	Operations team	Operations team
2nd level support	Incidences that cannot be resolved by the 1st level support	Product support team: 1st level	Product support team: 1st level	Project team	Product support team: 1st level
3rd level support	Incidences that cannot be resolved by the 2nd level support	Product support team: 2nd level	Product support team: 2nd level	Product support team: 1st level	Product support team: 2nd level
4th level support	Incidences that cannot be resolved by the 3rd level support			Product support team: 2nd level	

<sup>a</sup>Also called post-go live support

Needless to say, in ALL CASES (except for the pre-go live period of the project), the first level call-handling (and therefore, support) is really O&M's Service Desk (SD). As such, service desk personnel should be properly trained to try and resolve during the moment the incidence is reported without further escalation. In order for Service desk to be effective in this function (i.e. maximizing the number of first call resolutions), it must be properly trained and informed of commonly expected tickets. This can be done by:

- Formulating an FAQ (Frequently Asked Questions) with a format of Question, Analysis steps and Possible Resolution detailed in laymen's terms so that the service desk can easily follow and apply these
- Conducting a session before the go-live between the project team, the rest of the O&M team and the service desk agents describing the application that will be going live, overview of the process it encompasses, and review of expected common issues. These issues may be of any type, such as:
  - Settings (in the web browser, application, etc.)
  - Questions that may be typically asked for a user unfamiliar with the new application such as procedures
  - Where to find documents such as manuals and guides

- Permissions and password-related inquiries
- Errors that may be expected from improper usage of the system
- As a support, user manuals, PowerPoint presentations and videos can be prepared before going live and placed in a portal for users to access in case they need assistance on the procedure for using the new application.
- One may assume the typical errors and inquiries that are to be expected; however, the reality may be different, so that shortly after going live (a few days) the tickets for the new application must be analyzed. A new version of the FAQs and a new discussion with the service desk personnel should take place so as to fine-tune the procedures.
- Although this may seem obvious, it is important for the service desk to know who to escalate tickets to, which will also be explained below.

Once the different support levels are clearly defined for the project, then the service desk ticketing system must be configured accordingly. Some questions need to be answered:

- Will the project team be given direct access to the service desk system? If not, then who will handle the tickets escalated from the service desk in behalf of the project team?
- If the project team is given access, how many will have access and how will their responsibilities be delineated.
- Visibility over all the tickets. Typically, the O&M team should have this.
- How is the product support team to be contacted? The escalation procedure should be clear and ready for escalation.

Once having gone live, it is also important to see the trend of the incidence tickets, whether these are on the rise or declining. It is expected that shortly after going live the incidence tickets spike, but these should eventually decline. Failure to decline normally means that the root causes have not been addressed. Another important aspect is to check the rate in which the incidences are being resolved. If more incidences are being produced than being resolved, this means that incidences are accumulating, which may mean that either the root causes are not being addressed, the support manpower is insufficient, or both.

Typically, incidences will see a rise right after going live. This is typically 20–50% more for a system affecting multiple divisions, and will stay there for the first 2 weeks to a few months if business process changes are significant. For technical upgrades and changes with few business process changes, this rise of tickets will typically last for just a week if properly implemented. It is important however to observe that by the second week, the number of resolutions > the number of new opened incidences, otherwise the team will have a snowballing number of incidences to resolve. It is also important to:

- Analyze if several incidence tickets are the same (collapse them)
- There are several incidences related to a problem. In this case, problem tickets typically take longer to resolve, so that it should be escalated to the more experienced, 2nd, or even 3rd level support for investigation.

- Analyze those that are procedural (users not following procedure) or data-related (inconsistent or wrong data, usually also because of the users or legacy reasons). If these have been escalated to the AM support team, then an analysis should be done to see how the SD (or end-user department) can immediately resolve these so that they do not escalate. Typically, this is done by updating the FAQ and meeting between AM and SD (or end-user department) so that an understanding and explanation of the issues happens.
- Is there a technical issue? This needs to be addressed by TM.

If by the third week tickets continue to escalate, then either the system was very complicated and the users failed to understand its usage, or you have a major issue on hand, meaning, there is a problem with the design and/or deployment. Emergency meetings should be called between the different relevant teams and the users to get to the root cause, work-arounds identified, new advisories sent, and if needed, additional training, while the root case is being addressed.

Some incidences do not surface right after go-live, but remain hidden. Examples of this are incidences during the monthly closing of books, when rolling-over the budget (typically, yearly), or when the MRP (Material Resource Planning) is run. They will generally follow the same pattern, save for the delay. Particularly difficult are those that happen way-off from the go-live (such as during year end closing of books) as the project team may have been long gone, and the O&M team inexperienced still with the new setup.

As an example of a go-live that was stabilized, take when we implemented the single-sign-on (SSO) system in a company, wherein the user would need to sign on to Active Directory and would automatically get the correct access and permissions for all systems (vs. having to have separate login and passwords for each system). To do this, several steps were undertaken:

- A mapping was done for each application to the AD account. This means that every application's user account needs to be matched to its corresponding AD account. Sometimes the account name is distinctly different, so that matching these is not evident.
- Each application has to be "tied" to the AD controller, so that the credentials from the AD server are passed to each application
- Each end-user in turn needs to have a security certificate in his endpoint, so that the single-sign on system can recognize the endpoint as valid.
- A Single-sign on system is set-up for some applications requiring this particular service. This now becomes the hub for authorizing these applications after checking with the authorization at the endpoint (certificate) and the AD server.
- The certificates need to be pushed to each endpoint.
- The new links to the SSO-enabled applications are now pushed to each endpoint.

WEEKLY TICKET TREND  
YEAR 2014

		Mar-15				Apr-15			
CLASS	Tickets for the Week	3rd	4th	5th	Total	1st	2nd	3rd	Total
INCIDENT	Created	106	79	201	556	185	73	63	321
	Closed	6	8	4	26	4	4	5	13
	Cancelled	31	28	53	174	83	18	12	113
	Resolved	7	2	18	31	12	4	6	22
	Resolved (Waiting)	30	11	18	93	20	18	13	51
	Open	8	14	56	103	21	9	9	39
	Pending (Waiting)	24	16	52	129	45	20	18	83
	All Resolved Tickets	43	21	40	110	36	26	24	86
	Resolved %	57.33%	41.18%	27.03%	47.53%	35.29%	47.27%	47.06%	43.21%
	Resolved % (excluding pending)	84.31%	60.00%	41.67%		63.16%	74.29%	72.73%	
	All Carried Over Tickets From Last Week	145	141	140	746	276	265	170	711
	Closed	5	2	2	19	10	8	3	21
	Cancelled	14	8	4	47	33	73	13	119
	Resolved	4	6	1	20	9	16	6	31
	Resolved (Waiting)	14	15	8	75	28	27	14	69
	Open	0	2	1	5	3	4	1	8
	Pending (Waiting)	108	108	124	580	193	137	133	463
	All Resolved Tickets	23	23	11	103	47	51	23	121
	Resolved %	17.56%	17.29%	8.09%	18.55%	19.34%	26.56%	14.65%	20.18%
	Resolved % (excluding pending)	100.00%	92.00%	91.67%		94.00%	92.73%	95.83%	

Fig. 6.4 Example of a go-live project and resulting incidence tickets

As you can see from above, it is both a technical deployment, and a data cleanup exercise, and several things can go wrong.

Upon going live on the fifth week of March, the resulting tickets were created as shown in Fig. 6.4.

As can be seen during the fifth week of March, the number of incidence tickets more than doubled, due to the extent of the change. Upon investigation, several incidences were found:

- In some cases, the certificates did not push correctly, or the links did not. This was addressed by US in pushing those certificates again.
- Other cases were procedural; the users were accessing the old non-SSO enabled link. SD reacted by advising each caller on this, releasing an advisory reminding people, as well as deleting wherever possible the old link.
- Some of the mappings were incomplete, so some users were not able to login to some of the applications because they were not initially enabled to do so. In this case, AM took each one case by case and validated that the user is indeed authorized to access such application.
- In some rare cases, there were technical issues with the AD and SSO, but these were minimal, so that in fact the networks group actually did not have to conduct much work.

As can be seen from above, tickets normalized after 2 weeks.

## Further Reading

Cut-over forms part of IT Project Management, however, scant attention has been given to it, which is remarkable when one realizes that it is a very crucial part of the success of a project. The following publications touch on peripheral topics.

Kalaimani, J., 2016. Approach to Cut Over and Go Live Best Practices. In: *SAP Project Management Pitfalls*. Apress, pp. 93â€“105.

Morris, J., 2012. *Practical Data Migration*. 2nd ed. BCS.

Olson, T., 2015. *Digital Project Management: The Complete Step-by-Step Guide to a Successful Launch*. J. Ross Publishing, Inc.



*IT Operations governance is mainly defined in the IT operations policy that is regularly managed and updated by IT's O&M. Project governance however is related to both IT governance and company governance, and defines the control and authority given to the members of each project, and defines the manner and processes in which they are to conform to, usually as defined by the portfolio manager. Both IT operations and project governance are guided by the overall corporate governance and at the policy level, may be captured by ISO20000, ISO9001 and ISO27000 certifications, but these need to be translated to the work instructions that operationalize them.*

*Essential to project governance are how a project is created, the roles and responsibilities of the different project members and how the project is to be monitored and controlled. Risk, communication and release management are aspects of the project which also need to be defined at the operational level, in terms of how it needs to be conducted. Release management is especially important as usually the project environment being used is also shared with operations, so that roles and responsibilities need to be clear in order to avoid conflicts in the release of Configuration Items. Other aspects of project governance which usually have to be in sync with operations are code development guidelines, test, training, backup and recovery, security, and service desk usage guidelines.*

*Lastly, due to the changing nature of the project's requirements, request for infrastructure and scope (change requests) are normal. A clear method for requesting additional infrastructure must be set, as well as the method and approval process for change requests.*

Project governance is a component of IT governance as explained below, and sits side by side with IT operations governance. Many of the dimensions of project governance discussed in this chapter were also discussed in Chap. 5, but here we make more emphasis on what are the minimal required processes and documentation needed in order to comply with governance best practices.

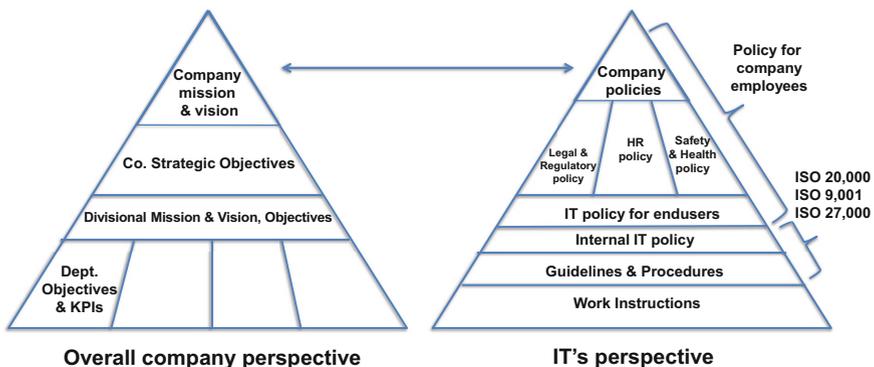
## 7.1 Overall IT Governance

Governance refers to all policies, guidelines and procedures which must be followed by the IT organization. In general, these are defined at different organizational levels and are cascaded down the organization by means of detailing them successively.

From Fig. 7.1, we can see on the left how company mission & vision is cascaded down the organization. Ideally, each division's mission and vision, as well as objectives should be aligned to its higher level, meaning, that the attainment of each's division's objectives contribute to the overall company objectives, and in turn, to the company's mission and vision.

Company objectives, mission and vision are of course usually very high level in nature, so there is a need to operationalize them. On the right hand side we see a pyramid depicting the company policies cascaded all the way down to the work instructions. Company policies should be aligned with the overall company mission & vision. This policy in turn, must be defined in more detail in terms of HR, legal, regulatory, safety & health, and IT policies. IT policies are not only restricted by the former, so that they should not be in conflict, but even more, it should be in fact supporting them, as in today's business environment, IT is in fact used to operationalize company-wide, HR, legal and regulatory policies, to ensure they are followed by means of business processes which reflect these, as well as monitor, control and audit these. IT policies apply not only to the IT Division's personnel, but some also apply company-wide. Common areas for policy are:

- **Implementing new services:** how are new services requested, approved, created and made part of the service portfolio
- **Service Delivery Management:** how are services delivered to the end-users, SLAs by which they will conform to
- **Incidence and Problem Management:** what are considered incidences and problems, how do they have to be reported, how they are handled, resolved, and closed.



**Fig. 7.1** Company governance and relation to IT governance, policy

- **Security:** policies on access, confidentiality, integrity of data and systems
- **Service Continuity and Disaster Recovery:** manner in which service is provided and restored when a disaster occurs, when is the disaster recovery plan to be called, SLA that kicks in once the disaster has triggered.
- **Customer Relationship Management:** policies relating to IT with regards to the company's customers and clients
- **Supplier Management:** policies relating to IT with regards to suppliers and contractors
- **Configuration Management and Change Management:** how configuration changes are requested, approved, created, and released
- **Release Management:** manner in which changes are released into production
- **Project Management:** policies related to projects which require IT resources, including IT projects themselves

From the point of view of the end-users, the following are typical policies that apply to them:

- Email usage policy
- Internet usage policy
- Security policy
- Requests in accessing a service
- requests for infrastructure
- requests for new applications
- Requests for major enhancements
- Policy on requests for application modifications and enhancements
- Requests for PCs, laptop, printers, tablets, smartphones, scanners and other endpoint and peripheral devices
- Service Desk policy

IT policies can in turn be taken one level down in the form of guidelines and procedures which are designed mainly for IT's internal personnel:

- Availability management. Including how to measure and manage it.
- Capacity management. Includes how to measure and manage it.
- Change and release management. The whole process for requesting, approving, planning and releasing changes, including possible roll-back procedures.
- System backup and recovery.
- Disaster Recovery Plan
- Service Desk. Ticket categories, opening, escalating, and filling-up of ticket details until closing.
- Configuration Management. Including scope of the configuration management (servers, applications, switches, etc.) and definition of the Configuration Management DB (CMDB).

As represented on the right hand triangle of Fig. 7.1, the topmost policies apply to all the different employees of the company (end-users from IT's point of view). Also, ISO certification including ISO20000, which focuses on IT O&M, ISO9001 which focuses on standards and procedures, as well as ISO27000 which focuses on IT security, will cover policies, operational procedures, but not go down to the work instruction level.

To illustrate the difference in what each level means, take for example IT backup policy. At the policy level, it may be indicated that all major systems need to be regularly backed-up. Procedures will indicate the criteria for backing up, retention period, and how backup media is to be retained. Work instructions will indicate the exact *HOW* to undertake the backup, including what tools, specific media, how often, what type of backup, and how the media will be managed.

## 7.2 Project Governance and Operations Governance

Most ISO standards provide clear guidelines to O&M; however, they are quite weak on project governance.

Clearly, projects will eventually turn-over to O&M, so that project policy and governance need, to be in sync with that of operations, however, the reality is that there are only few areas in operations which really have a direct effect on the project. To name these:

- Security policy
- Email and internet policy
- Endpoint policy
- Service Desk policy; and
- Request for infrastructure

Since projects are not in production, they may have their own particularities which make their requirements on the above, not exactly the same. The most important aspect thus is that upon *turnover to O&M*, the operational policies are followed, and all the necessary configurations to comply with these are implemented. Project policy may in fact differ, especially so because the project environment may be completely isolated from the rest of the infrastructure, users, and sometimes may even be in a different physical location.

It is thus important that the head of the project portfolio be the one to define project policy and governance for all projects, and the Project Manager apply these to his specific project. Variations from the general project policy may be acceptable, for as long as the PM seeks proper approval.

Project policy should cover the following:

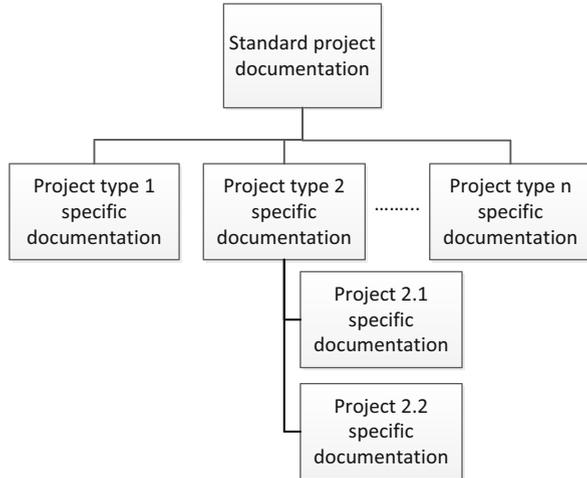
- **Project Monitoring and Control:** How projects are to be monitored in terms of templates to be used, roles in terms of personnel that are involved in the reporting and control activities

- **Project team roles and responsibilities:** roles and responsibilities of different team members
- **Communication management:** explaining different stakeholders that require communication, frequency of communication, as well as media used for communicating.
- **Scope management, including change requests:** how the changes in scope are to be requested, costed, and approved.
- **Risk Management:** templates used in risk management, frequency of risk analysis, personnel involved in the risk analysis.
- **Asset Management:** policy regarding the usage of company issued assets for projects
- **Incidence and issue management:** how incidences and issues are identified, created, approved and resolved.
- **Release management:** how releases are to be managed within the project (typically from DEV to QA) and also to production, as well as any other environments which may exist
- **Infrastructure capacity management:** manner in which capacity is to be measured and managed (in case additional capacity is needed)
- **Request management for projects:** how are new requests to be created, costed, approved
- **Code development guidelines:** do's and don'ts, code structure, documentation, security
- **Test guidelines:** how to test, who will test, formats for test scripts, including any tools utilized
- **Training guidelines:** format and general content, method of training
- **Backup and recovery policy:** manner of backups, frequency, what to backup
- **Pre-go live guidelines:** minimum requirements before going live, verifications and actions to be conducted after going live. Who makes the final decision for go-live?
- **Service Desk usage policy:** manner in which projects will use the service desk system, access
- **Post-implementation support and warranty period policy:** minimum requirements for post-implementation support and warranty, definition of roles
- **Security guidelines** (these are normally the same as for O&M)

All of these policies and guidelines have in turn, a set of documentation, which should as much as possible, be standardized across all projects. However, as IT projects vary quite considerably in technology, process, application, etc. project documentation may be standardized according to TYPE of project as well, and also, be further adapted to the needs of the particular project in question by customizing it to the project type, as shown in Fig. 7.2.

The exact project documentation should be discussed and agreed by both the vendor PM and the client PM, and then approved by the portfolio manager.

**Fig. 7.2** Standard project documentation vs. project specific



### 7.3 Project Monitoring and Control

It is imperative that both PMs (vendor and client), the Portfolio manager and the key stakeholders know exactly how the project is doing at any moment in time in terms of scope (quality), time, cost and resources. Communication to each party shall vary as discussed in the later section, but for the PMs and the portfolio manager, the same set of reports and tools can be used for reporting. Three essential tools can be defined here:

- **Project Management tool** (such as MS Project, Primavera, etc.): as defined in Sect. 5.1.4, this gives an updated view as to what tasks have been finished, what not, if there are delays, if it affects the overall timeline, CPI and SPI calculations (S-curve), resource utilization, deliverables attained. In fact, in one brief view and snapshot, the PM can understand exactly the progress and status of the project. A sample is shown in Fig. 7.3.
- **Issue registry:** is a list of all issues encountered and/or reported for the project. These issues can be reported by any party (either PM, an end-user, the O&M team, a stakeholder). It is registered into this sheet until it is resolved or cancelled (because it ceases to be an issue, not relevant, or due to other reasons), the date identified, the person responsible for seeking resolution of the issue, status of the issue and any remarks. An issue registry may be as simple as an excel sheet which enumerates all current issues and their status, as shown in Fig. 7.4.

The fields that are important include the status, who resolved the issue

Task Name	Duration	Start	Finish	% Complete	SPI
<b>BI Phase 2 Build</b>	<b>252 days</b>	<b>Wed 8/13/14</b>	<b>Fri 8/14/15</b>	<b>13%</b>	<b>0.13</b>
Project Initiation	9 days	Wed 8/13/14	Thu 8/28/14	100%	0
Project Initiation	9 days	Wed 8/13/14	Thu 8/28/14	100%	0
<b>Integrated System Design and Test Plan</b>	<b>10 days</b>	<b>Fri 8/29/14</b>	<b>Thu 9/11/14</b>	<b>100%</b>	<b>0</b>
Document System Design and Test Plan	5 days	Fri 8/29/14	Thu 9/4/14	100%	0
Present System Design to customer	1 day	Fri 9/5/14	Fri 9/5/14	100%	0
Revise System Design	1 day	Mon 9/8/14	Mon 9/8/14	100%	0
Submit revised System Design	0 days	Mon 9/8/14	Mon 9/8/14	100%	0
Accept System Design	4 days	Mon 9/8/14	Thu 9/11/14	100%	0
Milestone: Signed off System Design	0 days	Thu 9/11/14	Thu 9/11/14	100%	0
Present Test Plan to Maynilad	1 day	Fri 9/5/14	Fri 9/5/14	100%	0
Revise Test Plan	1 day	Mon 9/8/14	Mon 9/8/14	100%	0
Submit revised Test Plan	0 days	Mon 9/8/14	Mon 9/8/14	100%	0
Accept Test Plan	4 days	Mon 9/8/14	Thu 9/11/14	100%	0
Milestone: Signed Off Test Plan	1 day	Thu 9/11/14	Thu 9/11/14	100%	0
<b>Construction Waves</b>	<b>164 days</b>	<b>Fri 9/12/14</b>	<b>Fri 5/8/15</b>	<b>9%</b>	<b>0</b>
Wave 1: Purchasing & Inventory	75 days	Fri 9/12/14	Mon 12/29/14	19%	0
System Development	52 days	Fri 9/12/14	Mon 11/24/14	28%	0
Out of the box implementation	31 days	Fri 9/12/14	Fri 10/24/14	51%	0
ETL ( Development environmer	27 days	Fri 9/12/14	Mon 10/20/14	55%	0

**Fig. 7.3** Sample project plan showing milestones, % completion and SPI

- **Request registry:** is similarly, a list of any and all requests for the project which affect/modify the original scope of work. This is again similar to the issue registry in which any party can raise the request, and carries the same set of fields as above. A request need or need not have monetary implication, may or may not be accepted, but is registered anyways, for as long as it was raised and is within the project’s influence area. Again, a simple excel sheet may be used to track requests as shown in Fig. 7.5.

With the above three, the PM can scan the project management status, check for delays and how it affects the overall project timeline and cost, zero in on the task (s) causing the delays, and open the issue registry to identify the underlying cause for the delay.

An additional governance document proves to be very useful:

- **Deliverable checklist**—is a document with the list of all deliverables agreed for the project, the phase of the project in which it is to be generated (initiation, blueprint and design, development, . . .), who it will be prepared by, status, date submitted, who is to produce the document, description, whether it requires a sign-off, and who shall be the signatories and approvers.

One way to do this is through an excel sheet which already contains a predefined set of deliverables normally needed for IT projects as shown in Fig. 7.6.

This checklist would then be customized by the PMs in mutual agreement.

What this document allows is for the PM to quickly view the list of all submitted deliverables, and determine what is pending, so he/she can follow-up. Deliverables

Bills Presentment Issue Register					
No.	Issue	Updates	Status	Resolved by	Bills Presentment Team Notes
1	SMS Gateway - telecom co. unable to provide the transaction status for each of the SMS sent (Success/Fail); currently they are only providing numerical statistics of successfully and failed SMS sending	April 1 : customer has raised a request for telecom co. to provide the status per SMS sent  April 17 : Meeting with telecom co. clarified items on the transactions status. customer will be able to extract SMS transaction status per SMS sent via web service	Closed	Joan	Impact: Reports on SMS sent status will not be available  April 15 - A second meeting has been requested by telecom co. to answer previous meeting's questions and requirements as well as to clarify more the customer requirements from them.  April 17 - telecom co. will ensure that the custom application and web services should be ready for Bills Presentment preliminary Integration Testing by May 15, 2016. Demo telecom co. accounts will be requested 2-weeks before the testing week.
2	SMS Gateway - telecom co. unable to filter incoming messages and has no automated facility to send to customer	April 1 : customer requested for telecom co. to find out if they can provide filtered incoming SMS and automated sending of this files to	Closed	Noel	Impact: Enrolment via SMS functionality will not be available should telecom co. not be able to provide incoming SMS file  April 15 - A second meeting has been requested by telecom co. to answer previous meeting's questions and requirements as
3	Unified Payment Gateway - identification of the unified gateway to link to	April 1 : customer arranged for a meeting with Treasury department	Closed	Tess	Impact: Availability of the link to payment gateway  April 8 - There will be a dropdown box for the Pay Now option within the Bills Presentment System will contain the list of financial institutions customer has existing MOA. This list will be maintainable.
4	DSP/principal Technical Foreign Resource On-site work commitment to ensure functional and technical design are sound and ensure quality	April 22 : Advise was received from customer CIO, that architectural meetings with customer will be put on hold until the principal experts are present here in project site so that discussions will be more comprehensive and assuring that what is designed is feasible	Open	DSP	Impact: Scheduled architectural review (functional and design document) may be delayed due to the pending response from DSP/principal <April 22-29> same status <May 5> DSP has responded with a schedule of the resources working on-site and off-site. Sajid and Sathish went onsite to work with customer for the Blueprint/Design review sessions. <May 8> New project TO was given to company Continuous monitoring of resource and resource work is going to be done.

**Fig. 7.4** Sample issue register (partial register shown)

may be anything including a kick-off meeting, a blueprint, technical design, actual code, UAT, training, manuals, meeting, etc. Again, since every project is different, the exact deliverables to be produced will be agreed upon at the start of the project by both PMs. Generally, technical projects carry less deliverables than applications that touch on process, and the more processes that span across different departments; the more documentation is usually needed.

Aside from this, it is also important to choose proper deliverables so that the real progress of the project can be monitored. Deliverables are milestones which help to understand whether the project has progressed or not to that stage. Deliverables should preferably be:

- **Easily identified**
- **Objective**—either they are attained or not, there should be no room for ambiguity
- **Clear in terms of whether they have been achieved.** Is the objective attained upon submission? Approval? Sign-off by users?

**Bills Presentment Request Tracker**

No.	Portal Type	Request	Requester	Updates	Status	Resolved by	Resolution Code (ticket#)
1	Service Desk Ticket# 9608	Infrastructure Set-up - Development	Tess	Infrastructure request approved 3/31 Completed 4/14	Completed	customer Infra Team	9608
2	Service Desk Ticket# 9608	Infrastructure Set-up - QAS	Tess	Infrastructure request approved 3/31 Completed 4/14	Completed	customer Infra Team	9608
3	Service Desk Ticket# 9608	Infrastructure Set-up - Production	Tess	Infrastructure request approved 3/31 Pending QAS	WIP		
4		Addition of Payment Status notification	John	4/10 - CR form being created by SI (estimates on effort and costs)	Cancelled CR		
5		Provision of additional drives for Software installation and DB	John	5/25 - Aligned with customer's requirements of no storing to Drive C; Request raised	Completed	customer infra team	
6	14445, 14728	Request for QAS environment provisioning update	Tess	June 16 - For Approval	Completed	customer infra team	
7		Smart Test Accounts needed IP address	John	June 28 - Request raised	Completed		
8		Smart Test Accounts needed IP address for Cloud	Anne	July 29 - Request raised. As per Max's response, it can only be provided once Cloud server set-up	Completed		

**Fig. 7.5** Sample request register (partial register shown)

- **Spaced along the life of the project.** In this way, it is easy to monitor progress. It is usually hard to place deliverables during the development phase, especially if development of different modules or functions occurs simultaneously.
- **Usable.** Preferably, the deliverable should be of actual use to the project, and not merely for the purpose of project tracking, so that the effort in producing this deliverable is not wasted.

Sample of badly defined milestones includes:

- % completion of development—because this is hard to measure and have to take the vendor’s word for it, it is also normally too long a phase which would require milestones within it.
- % tested—if this is not measured by pass/fail, then it is a bad measure because it is not objective. Testing typically requires several iterations of testing

Project Phase	Deliverable	optional?	Prepared By	Status	Date submitted or signed-off	Description	Undertaken by	Sign-off required ?	List of Signatories
Blueprinting and Design	Process flows level 0,1,2,3 (up to level applicable)	No	Vendor	ON-GOING		Visio, explanation in word document. See standard document.	Vendor PM	Yes	Customer users, PM, IS Head, CIO. Optional as case may be: - Operations Head
	Functional Design	No	Vendor	DONE	22 July, 2015	Format varies per application and thus, should be agreed-upon at project start. This document however, shall contain details on the functional aspects of the solution in how it meets the BRD	Vendor PM	Yes	Customer users, Customer PM, IS Head, CIO. Optional as case may be: - Operations Head
	Technical Design	No	Vendor	ON-GOING		Format varies per application and thus, should be agreed-upon at project start. This document however, shall contain details on the technical aspects of the solution, and is a further elaboration on the IT infra discussion.  PM must ensure that DEV, QA, Testing and PROD environments are all properly licensed (or if license is waived for some), so as not to have issues later on.	Vendor PM	Yes	TM Head, IT Head, Customer PM, CIO
	Backup procedure	No	Vendor			Should contain details of the backup procedure (instruction level) for the application  should include procedure for changing admin passwords	Vendor PM	Yes	TM Head, CIO

**Fig. 7.6** Sample deliverables checklist (partial list shown)

- Blueprint defined—again, the blueprint may have been drafted, but there is no guarantee that the blueprint is correct nor accepted. If this immediately leads to development without proper acceptance, it is a “false” milestone.

From the PMs’ point of view, projects will also be monitored and controlled by means of regular project update meetings, usually weekly. During these meetings, the documentation mentioned above is reviewed, analyzed, and major issues raised for clarification and decision-making. The risk analysis register, if utilized, will also be updated.

These project update meetings should be kept short (1 h), unless (exceptionally) there are a lot of topics that need to be covered. Mandatory in these meetings is the presence of the two PMs; the rest of the attendees will be invited depending on the communication plan decided. From time to time, key users, the portfolio manager, project sponsor, project team lead, key personnel from the Customer’s Operations and support team will be invited, if and when their involvement, inputs or decision is required.

## 7.4 Project Team Roles and Responsibilities

Project team members, stakeholders should have clear roles and responsibilities. Generally speaking, the PM should be the single point of contact and singly responsible for the delivery of the whole project. He shall also be in charge of:

- Scope mgmt.
- Time mgmt.
- Cost management
- Quality
- Resources
- Risk Management
- Asset Management
- Governance and reporting
- Communication management
- Procurement and contract management

The roles and responsibilities of the other project team members (whether full or part time) shall depend to a large extent on the type of project, structure and model used by the client and vendor organizations. Some of the typical roles that exist are (those marked with \* are more uncommon, V refers to a vendor role, C to a client role):

- **Business Analyst (V)**—is a functional expert that will be in charge of capturing and translating business requirements into functional specifications for the design and configuration of the application, as well as codes that need to be developed. Many times, the analyst is also in charge of executing the configuration changes on the application.
- **Programmer (V)**—is the person that will code using the pertinent programming language as per the specifications developed by the Business Analyst.
- **Technical manager/System Architect (V)**—is in charge of determining the necessary infrastructure for the execution of the project. Will also be in charge of designing the overall architecture, as well as sizing servers, storage, and determining hardware and software components needed, including network requirements. Will coordinate extensively with the customer Technical Manager to ensure the architecture is compatible, and complies with the customer's technical infrastructure and policies. His role in the project is usually temporary, with a heavy involvement in the beginning when the overall architecture needs to be designed, the functional specifications translated to technical specifications, as well as shortly before the go-live.
- **Technical support personnel (V)**—may include a Database Administrator, Network Administrator, System Administrator(s) that will each be in charge of installing, creating, configuring, defining permissions, and maintaining during the course of the project the Database, network, Application(s) used, respectively. Will communicate extensively with the client's counterparts.

- **Tester (V\*)**—will be in charge of defining the test scripts and running the tests before UAT. These personnel may be a complement to the business analysts, and will work closely with them, or is a role taken on entirely by the Business Analysts.
- **Documentation writers (V\*)**—will be in charge of the documentation of the project, including process flows, end-user requirements, manuals, etc. Is a role also complementing that of the Business Analyst, and may be a role taken entirely by the Business Analysts.
- **Process experts (C)**—are the end-users that are experts in the business or business processes that will be covered by the project. They will give information, data, and interviews and should be the main approvers for the deliverables of the Business Analysts, namely, the end-user requirement documents, functional design and specifications, as well as the main testers during UAT.
- **Technical support personnel (under the TM team) (C)**—the counterparts of the project technical support personnel, will be in charge of reviewing and approving their corresponding parts which will later on turned-over to them, including sufficiency and clarity of documentation. They will also assist the project (on a part-time, as need basis) for any requests for infrastructure.

It is important that the project team's role be clearly defined from the beginning of the project. A good moment to formalize these roles are during the kick off, so that especially the process experts are identified and they commit to the project (as they are usually from the end-users' side). Specific roles can be displayed on a screen or board, and the corresponding name written down. Their exact role during the project should be well explained, and by having their boss during the kick-off meeting, their role formalized.

Aside from the project team itself, a steering committee may be needed for the smooth conduct of the project. The role of the steering committee is to act as a body that will guide, and if necessary decide and approve matters which cannot be decided at the project management level. Some of these may be:

- Disputes that cannot be resolved at the Project Management level
- Decisions which affect policy or in which policy changes need to be made
- Conflicts which exist between different departments and which need to be decided at a higher level (not a decision IT can or should make)

Aside from these, the steering committee meeting may also be called for:

- Progress updates
- Informing them of major changes that will happen due to the project
- Inform different departments that even though they are not directly part of the project, but will also be affected somehow.
- Seek clearance for additional budget, scope or resources, if necessary

The exact role and times the steering committee is called for a meeting will depend on the type of project and the company culture. Some companies' senior

management like to take a hands-on approach and be involved closely with IT projects, especially if the project is strategic for the business, while others may entrust the details to the IT Department, and just wish to be informed on major milestones and progress. In any case, this needs to be determined as explained in the Communications Management section.

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## 7.5 Communication Management

Communication management policy indicates who should be informed and the means and regularity to which they are to be informed. This is generally very much project-dependent, but the policy should describe the bare minimum required. This would normally be in the form of:

- **Kick off:** the first formal project meeting with end-users, PMs and other key stakeholders. This meeting is important in briefly describing the scope, timeline, table of organization, methodology to be used, disseminating the communication plan for the project, details of the project governance (if needed), identifying needed project resources and assets, as well as identifying and getting the commitment of stakeholders needed in the project. For example, getting the commitment in terms of time and dedication of the end-users for the blueprinting sessions and testing. The requested commitment should be as explicit as possible.
- **Project update meetings:** normally weekly and preferably pre-defined in terms of the date and time these shall take place, but depending on the phase, risk and criticality of the project, may be called for more often (every day in the 2 weeks before going live, for example)
- **Steering committee meetings**—indicating the criteria to be used for calling the steering committee for a meeting, or if regularly scheduled. Also important is to validate the members of the steering committee meeting, which would generally depend on the type of project (e.g. CEO, COO, CFO, CIO may form part by default, Head of Logistics invited due to the project dealing with a logistics optimization)

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## 7.6 Scope Management (Including Change Requests)

As stated before, scope management is usually the single, biggest source of failure in a project. Disputes commonly occur with regards to the inclusion and exclusion of certain functions, as well as the perceived quality of the solution. This means that scope should be as clear as possible upon the start of the project, and should be handled correctly during the whole lifecycle of the project.

All IT projects are successively elaborated with regards to scope, while usually maintaining quality standards and managing costs and resources to be as close as possible to the baseline. As such, the level of scope detail should progress as the

project progresses in time. Take for example the standard documentation below, which is arranged in the order of project start to project finish:

- Terms of Reference (tender document)
- Proposal
- Proposal clarifications
- Contract
- End-user requirements
- Functional design
- Technical design
- Blueprint
- Coding design
- User manuals

With each successive step, the exact scope of the project is being further elaborated in details (scope, quality). As most projects would be turn key (fixed price), the challenge of the PMs is to keep the scope within the reasonable bounds of what was tendered (and successively detailed), so that no additional price or resources are needed. Any specifications that do not conform to this are therefore called a change request, which means that these are additional specifications that were not part of the agreed-upon scope. Before we go into details of the change request, let us first review the list of documents above, and try to understand how scope discrepancies and misunderstanding between the two parties can be minimized.

Firstly, it must be understood that what is binding to both parties is the scope of work as detailed in the contract. This is a legally binding document which, in case of disputes, is the primary document to be consulted and defended in case of arbitration or any legal actions taken to resolve the dispute. As scope has been successively detailed from the moment the project was tendered, it is important that the contract correctly capture all these details appearing in documents elaborated and agreed upon by both parties between the moment of tender and the moment the contract is signed. One way to do this is to write into the Scope of Work (SOW) what was agreed, including all those agreements during clarification meetings and presentations, and include it as part of the contract. This may take time, first to draft, making sure all points discussed are reflected, then to review from both sides and agree. A simpler way to do this is to just mechanically attach all relevant documents as annexes being referred to by the main, standard contract (which should not be changed). Thus, the Terms-of-reference released by the client, the proposal submitted by the vendor, and the minutes of the meetings between both parties with all agreements and clarifications should be attached, and their precedence (in case of conflicts between them), stipulated in the main contract. In this way, all agreements including clarifications are made contractually binding.

Another important advantage of this method is that the contract can be standardized (more in Sect. 5.1.3), and the vendors' commitments stated in the proposal made part of the tender contract. After all, who has not experienced of

vendors indicating something in the proposal which is eventually “forgotten” as it was not explicitly indicated in the contract. Furthermore, having the vendor aware that all replies in the proposal are in fact contractually binding, they will in fact think twice before overcommitting or even bending facts just to win the contract.

Let us now go back to the topic of to change requests. Although change requests are a dirty word in many organizations, they need not be so. Properly managed change requests can in fact be very useful, as will be explained shortly.

The first and most important tool for identifying *possible* change requests is the request registry. As explained, any request that has been flagged by any stakeholder is to be registered into this document for further analysis. Firstly, it needs to be analyzed whether the request is actually outside the SOW. If so the next question is whether this request is reasonable, in terms of:

- **Functionality and usability.** Is it really necessary or is it a nice to have? Is this only an individual’s request or is a functionality which will be used by many?
- **Is it a key requirement?** Such that, not having it will be a major issue
- **Cost.** How many man-days estimate? If not quantified yet, at last have an idea whether this is a major change or if it is just a small effort.
- **Timing.** Is this necessary now before going-live or can it be taken as an enhancement in a subsequent phase? If included into the current project, will it affect the overall timeline? Will it form part of the critical path?
- **Resources.** Are they available for this within the project’s current table of organization? Or should they be sourced externally? How long will it take to source?

Take note that cost is just one of the evaluation criteria, not the only one. Whether the requirement is key or not usually has much more weight as compared to other criteria. One needs to take into account the *overall* cost, not just the IT cost, which many times is forgotten. In other words, not having that additional scope may impair operations considerably, resulting in much more work, effort, lower customer experience or additional operational cost which must be weighed vs. the IT cost. It is in fact the job of the CIO to weigh all these factors (especially if it is a big change request, otherwise it can be handled by the PM or Portfolio Manager.) and make a decision. It is also the job of the client PM to make a recommendation, and it is especially important for him to weigh the advantage of including that additional scope vs. the additional cost, and very importantly, the additional time delay and risk that the change request will introduce. Sometimes, introducing the change immediately may not impact the overall timeframe too much, but it carries the risk that every whim and fancy from the end-users to include additional scope (assuming here that they were the ones to raise the request) will be accepted. If that then becomes the culture, then all these additional requests will eventually delay or even derail the project. If just for this reason alone, it may be recommended to just keep the request in the request registry and have a subsequent enhancement project to address these additional requests.

A sample of well-managed project creep occurred in a Business Intelligence project which had its delivery outputs already signed-off by the users. When development started however, some users realized that additional details on the fixed assets reports were needed. Including these would have meant restarting the development, so that instead, it was negotiated with the users to maintain them as-is, test and approve, and have a subsequent phase for such modifications. This was possible as these additional requirements were nice to have and further refinements of the original scope, but were in no way essential in the sense that their non-inclusion would invalidate the outputs.

Once the request has passed the initial screening, it now goes on to a formal “change request status” and main responsibility for filling-up the details is now the vendor’s PM. He now puts in motion his mechanism to formally propose the change request:

- Identify main person who can estimate the change request tasks and effort
- Identify the resources needed for the change request and check availability
- If not readily available, check the constraints or ability to source from other project pools or externally (subcontract)
- Identify the man-days for each resource needed to complete the change request.
- Cost the change request, including any margins applicable
- Get internal management approval

The change request proposal is then with the customer PM to evaluate, negotiate (if needed) and approve or disapprove. If the man-day rates were included as part of the contract then the money calculation of the change request is relatively easy and the customer PM need only to verify that the effort is reasonable vs. the request. In accordance with company and IT policy, the change request may need an additional contract, addendum to the main contract, or may be accepted as part of the main contract.

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## 7.7 Risk Management

As explained in Sect. 5.1.7 risk management may be called for, depending on the complexity of the project. The basic tool for this is the risk management registry, which evaluates both (+) and (–) risks, their probability, impact, as well mitigation steps. This would normally be done during the weekly project update meetings. Special risk management sessions will also be called by the PM during times when high-risk activities are drawing near, such as cut-over, data migration, release of new enhancements, etc. The content of this report and techniques has already been explained in the aforementioned section.

Policy should also indicate when to conduct risk management.

An example of how risk management can be extremely useful is that it is able to identify actions for reducing the risk of commonly risky activities. From experience, risky activities include:

- Interfaces
- Customization of non-standard processes
- Data migration
- Cut-over from a legacy system to a new system
- Cut-over from a legacy process to a completely new process (even if within the same application)
- Revenue-generating processes (invoicing, billing, sales. . .): this is due to the huge impact it may have on the company
- Production-related processes (production planning, inventory, purchasing, logistics, delivery)
- Regulatory compliance processes and reports
- Significant custom code used in an off-the-shelf application
- Processes involving major user change management

By conducting a risk analysis way before the risky activity is undertaken, it is possible to come up with practical, mitigating factors to address them.

Take the example of migration from a legacy marketing system to a new marketing system. Firstly, one of the risks identified was the quality and reliability of the customer data. As such, several actions were taken:

- Verify the accuracy of a sample of the data. From here it was determined that customer profile, address and contact numbers were dirty;
- Conduct a customer cleansing campaign where these details were verified via email and calls from agents trained appropriately
- Final cleansed data loaded, in order to minimize the risk of error, a sample slice of the data was also loaded into the new marketing system for testing and verification not only of the loading process, but also of the subsequent marketing process triggered by this data

This actually minimized the number of errors in the data, which in turn minimized errors in the process due to wrong triggers, resulting in a much shorter post go-live cleanup process and better customer image.

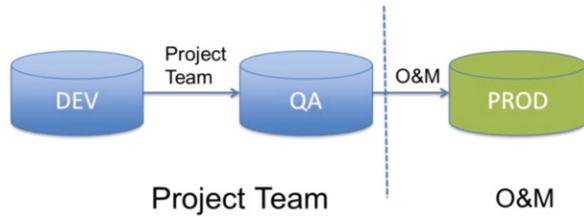
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## 7.8 Asset Management

Assets assigned to a project are the responsibility of the PM until formal turn-over to O&M. This means that servers, environments (which are not being used in production), switches, laptops and other devices are her responsibility. Not only is the PM accountable for the physical asset, but also for all intangibles such as installations, configuration items and the like, within these assets.

This has special relevance in the release management procedures because assets that are under a project (unless shared with O&M), are the full responsibility of the project team. In fact, as explained in the Chap. 6 under cut-over procedures, any

**Fig. 7.7** Project team in charge of DEV, QA, while O&M in charge of PROD setup



environment will be the responsibility of the project team until going live, and will only go-live once accepted by O&M.

Why should O&M have a role on the go-live? This is to ensure that the project team has made enough effort to convey and document what has been done for the project in terms of the configurations, environments, etc. As one can imagine, the project team is in a hurry to finish and turn-over the project, as any delays means additional cost or breach of the original planned timelines, however, as it is the O&M team that will eventually *support* the whole application and infrastructure, they must be able to understand what has been done, and this necessarily needs to be done before going live, even if there is a warranty period in which the vendor is still addressing project-related issues.

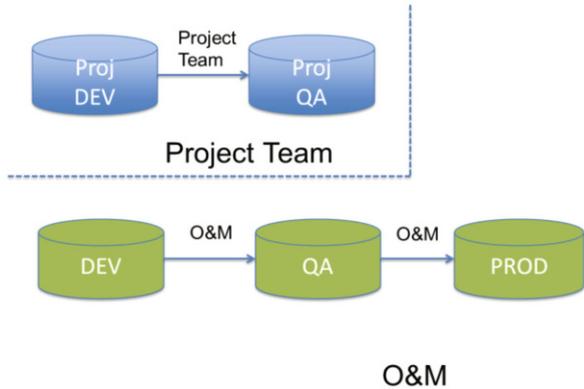
The other reason why O&M must have a say is to ensure that all work done by the project team conforms to IT standards and policies. While it is the job of the customer PM to ensure this is so, in reality, it is impossible for the PM to be knowledgeable of all technical details, because her knowledge is also limited. However, as the project will be turned-over to O&M, it is in fact a must that the O&M team understands the details of the application and infrastructure so that they can support it in the future. Either they would have the knowledge for the technology being used, or they should be required to acquire that knowledge before the turn-over, in the form of trainings, hand-holding, and other transition activities.

The responsibility over an asset becomes more complicated when the asset and/or environment is shared. In this case, the policy “Operations rules” applies, which means that overall responsibility will fall under O&M because as the system is in production (or under O&M’s responsibility), any changes, releases should not impair production, and thus, approval from O&M is needed for any release. How this is actually done depends on the situation. When it comes to applications and their environment, three possible scenarios exist:

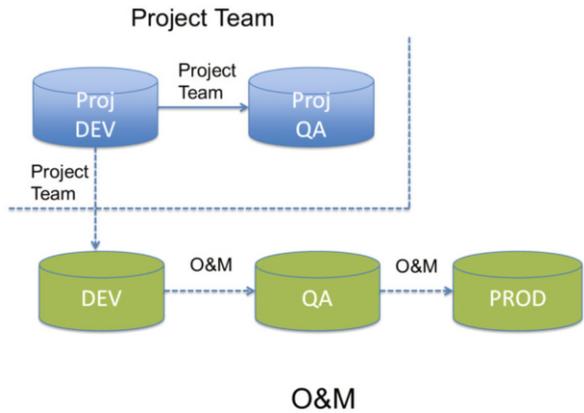
### **Scenario 1** O&M not conducting any changes in DEV, QA environments

This may be because there are very few requests and releases being undertaken for the application, or it may be by imposition. The latter is when a moratorium on changes is asked for by IT in order to undertake this major project. This of course may not always be acceptable or possible, and must be consulted with the different user departments affected. It simplifies cut-over, but if used too often for major systems, it will irritate the users. This is however the most risk-free scenario. Figure 7.7 illustrates which team is responsible for what environment.

**Fig. 7.8** Scenario with DEV, QA environments separate from O&M's



**Fig. 7.9** Copying of releases from Project DEV into Operations' DEV



As the project team shall be managing directly the DEV and QA environments, it is wise for O&M to conduct a backup of both before the responsibility is handed over to the project team. In this way, full restoration of the previous configurations and data can easily be done in case something goes wrong.

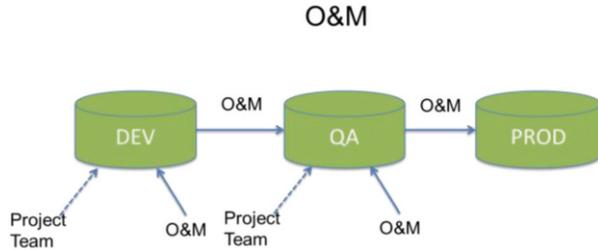
**Scenario 2** Project team is given a separate DEV, QA environment

This solves the problem of changes being made by two separate teams which may have conflicts between them. Of course, there will be no conflicts initially, but once both changes are tested on the same QA server, that is the moment the conflicts will become apparent. This initial scenario wherein both are using separate environments is represented by the diagram shown in Fig. 7.8.

However, at some point the configurations and changes made by the project team must be tested all together along with those made by O&M as shown in Fig. 7.9.

The dotted line arrow from the Project DEV to the O&M Dev shows how the new project releases must be reproduced into the O&M DEV. These configuration changes

**Fig. 7.10** Scenario with common DEV, QA shared by both project and O&M



must often times be done manually (would depend on the ability of the application to support releases), so there is a risk of course that changes not be reflected completely or correctly. The changes would be reproduced by the Project Team into the O&M DEV, and subsequent releases into QA and PROD will be done by the O&M team. Take note however that exhaustive regression testing needs to be done again both by the Project Team and O&M in the O&M QA, to ensure that no conflicts have occurred between the two teams' changes. Conflicts will need to be resolved by analyzing one by one their interdependencies, rolling them back, and retesting. Sometimes, this alone can be a major effort if changes were done on common functions or submodules.

An example of scenario 2 which we undertook is when we reconfigured the warehouse module of the existing ERP. Even while changes were being made in this module as part of operations (there were outstanding changes that could not be stopped) changes also were needed due to the warehouse module's major reconfiguration. To do this, a separate DEV and QA environment for the project were created and the project's development, testing and training proceeded independently to that of the releases and environment used by O&M. Once all the changes were accepted in the Project QA, these now had to be redeployed in the O&M DEV, by reproducing these changes manually (i.e. reconstructing each configuration change, one by one), then releasing them into the O&M QA and retesting all these changes again, as well as doing a complete regression testing so as to guarantee that the changes had no untoward impact to other CIs.

### Scenario 3 DEV, QA environments are shared

The advantage of this approach vs. scenario 2 is that conflicts are detected as they arise, meaning, once the testing is done in the common QA and maybe even as early as in DEV. This is conceptually illustrated in Fig. 7.10.

Both the project team and the O&M team conduct their changes directly into DEV, and test on the same environment, however, all releases are O&M's responsibility. Releases can thus be analyzed first for possible conflicts before releasing into QA, and can be rolled back easily before the releases accumulate.

Which scenario to choose? This would depend to a large degree on the number of releases being undertaken by O&M, the feasibility of calling for a freeze, as well as an analysis of which scenario will ultimately be easier to manage.

For pure infrastructure projects, the approach may be different if the infra project does not have the possibility of testing in DEV, QA environments. Attaching infrastructure directly to the current infra usually has an effect, as it is not easy to directly separate interdependencies. In such cases, what is usually recommended is to test in some separate environments:

- Laboratory environment—a contained, isolated environment which is used primarily for testing
- Pilot implementation—a selected group of users to use the infrastructure

Lab environment and pilot implementation are not always possible, as there is infrastructure which to really fully test, must be configured to run directly into production. Sometimes as well, to set-up a test environment is so much work that it is not practical to do so.

Take as an example a new firewall that is to be deployed. Even though the defined policies may have been tested thoroughly in a contained environment, deployment to production, when exposed to the live Internet connection and actual users, expose it to conditions which may not have been considered at all in the lab environment, and so policies and CIs would normally have to be tweaked once in production to fine-tune and attain the desired performance. Examples of this are policies which inadvertently created a loophole for traffic to pass through when it should have been blocked (for example) due to authentication policy issues that were not apparent in the lab environment.

### 7.8.1 Issue Management

Project issues and related incidences are first and foremost managed using the issue registry as defined above. Issues may in fact be varied in nature, but all should be registered and handled by the respective PMs. Typical issue types include:

- **Infrastructure-related:** insufficient capacity, incorrect CI, performance issues
- **Configuration related:** incorrect configuration
- **Non-compliance to scope:** did not comply to blueprint or other detailed specifications
- **Test failures**
- **Availability of users:** no testers, no trainers, no sign-offs, delayed sign-offs, difficult users
- **Availability of training infrastructure:** no training rooms, PCs not properly configured
- **License-related:** license expired, no QA license

It is important to flag the issue and identify the person responsible for addressing it. This list will be reviewed as part of the regular project monitoring and control activities.

An important aspect to take into account for system application and infrastructure related incidences (a subset of all issues), is that their resolution, root cause and any work-around applied need necessarily to be documented as part of the knowledge-base, this can follow the same document standard used for O&M's Knowledge Base (see Sect. 4.5). It is important to document these not only for the project team, but that these are turned-over to the O&M team as well.

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## **7.9 Release Management**

Release management for projects is much simpler than for operations as changes are not yet in production until the moment of go-live. As such, they should follow the release management procedures as defined in the earlier section (Asset Management). Once the project goes live or if the project is sharing some environment with O&M, then the procedures for release management used by O&M are then to be followed. Remember that the general rule is only one unit is responsible; there cannot be two responsible for releases. As such, O&M is always responsible for environments that are shared and has the last say in authorizing any releases.

Release requests are preferably handled through the Service Desk system and would follow the normal escalation procedures defined in it by O&M, and either direct access to the Service Desk is given to the vendor, or the client's PM raises the request on their behalf. Interdependencies between releases should also be taken into account when requesting for the release, such that any sequence that needs to be followed is to be indicated. All releases should also have a roll back procedure, as explained under O&M release management (see Sect. 4.4).

Releases that cause errors or incidences should be flagged and if needed, rolled-back, and they should trigger the issue management procedure including the documentation of solutions in the Knowledge Base, as explained earlier.

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## **7.10 Infrastructure Capacity Management**

Infrastructure needed by the project should also be defined during the proposal stage, so that the customer is made aware of the needed infrastructure, can provision for it, or start a purchase in case the hardware and other infrastructure is not available. Provisioning of infrastructure can be made using the regular request management process in O&M, which will undergo all the necessary approvals. It is of course important that even upon tendering, the vendor indicate how many environments are needed, as well as the particular requirements for each. Typically these would be DEV, QA, PROD, but additional TRAINING environments may be needed if development and testing is to continue in parallel with training. Other particular requirements should also be made clear.

Specifications for each environment given by the vendor is a starting point, however, as we all may very well know, sizing infrastructure is an art, not a science and is never exact. Most sizing tools ask for parameters which are hard to obtain, assumptions need to be made, some of which are wild guesses at best. As such, it is really upon going live that capacity aspects can be tweaked. In the past, since all servers were physical, this was difficult. Either you procured hardware with considerable buffers, or you would run the risk of falling short which would mean a delay in having to procure the additional hardware. Nowadays, with the prevalence of virtualization and cloud computing this endeavor has become much easier, as virtualization allows you to allocate resources on the fly, with little or no downtime. It thus becomes crucial to monitor hardware resources upon going live and tweak these accordingly till the desired performance is attained.

It is important that the technical specifications and architecture of the infrastructure be defined and agreed upon shortly after the project kick-off. This may seem difficult, but is necessary in order to avoid bigger problems later on. The architecture has to conform to several aspects of the client:

- Must conform to its standards in terms of hardware and software used
- Security compliance
- Sufficient capacity

It normally takes several sessions and discussions together before agreement of the final architecture is reached. This is a good exercise, because pros, cons are discussed, and the architecture dissected and analyzed for possible risks and non-compliance.

One particular painful experience which we lived was in a data analytics project which had several software components running at the same time. In this case the vendor assumed that the ETL server could reside in the same machine as the data mining server and went live without previously verifying the architecture. The result was that the performance of the different applications was very slow, so that the whole architecture had to be redesigned, and all the different software components reinstalled, reconfigured, and the applications retested resulting in a 20% delay in the project. All this could have been prevented by first verifying and getting a sign-off on the proposed architecture.

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## 7.11 Request Management for Projects

Requests may be of many different types and forms. Generally speaking, there are two types of requests:

- Those affecting project resources only; and
- Those affecting O&M (production mainly)

Both are reflected into the request registry as explained earlier. The first type are handled and resolved by the two PMs, they are basically related to scope management as explained in the earlier section and thus follow the change request procedure as explained under the scope management section. The second involves O&M, and as such, it is best handled by initiating the request in the normal way any operations stakeholder does, usually through the service desk. Common types of such requests are:

- Request for release (to QA/PROD)
- Request for additional infrastructure
- Request for change (to be handled by O&M)
- Request for backup/restore
- Request for development. This is in case any development needs to be undertaken by O&M, a typical example of this would be for interfaces, in which development needs to be undertaken at the system being interfaced to, by the project.
- Request for QA refresh. This is to refresh QA with updated data, which is usually a copy from production.

The project team is seen by O&M as just another user, and its requests are thus handled in the same manner as all other requests, except that their requests need to be necessarily endorsed and approved by the customer PM, as well as approved by the authority defined to approve such project requests (either the Portfolio Manager or the CIO, depending on the type of request). Approval levels should be clearly delineated by the policy, as well as the priority levels as assigned jointly by the PM and the Head of Operations.

If the project requests are to be routed via the existing O&M Service Desk, then it should be clear that this is the method, and not just a verbal request.

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## 7.12 Code Development Guidelines

Code development guidelines encompass the necessary aspects that need to be followed by the project code developers. These may include:

- Naming conventions for programs, objects, tables, variables, etc. . . Should also indicate common best practices such as not hard-coding values into programs, using relative (vs. absolute paths), and others.
- Documentation format and details required. As it is very difficult for a person not involved directly in the development of the program, all code should come accompanied with a functional description of what the program does. Also, to make it easier, each program should contain a header with the mandatory information describing the program.
- Network Domain name conventions. Should also specify the avoidance of using IP addresses, as these change over time.
- Error and exception handling

- Message types and convention
- Tables and objects. Description of mandatory fields, as well as necessary descriptions for each.
- Indexing. When and how to create indexes.
- Performance standards. Includes treatment and usage of dead code, subroutines, nesting, conditions, CASE statements, SELECT statements, and all other code types which structure may have a significant impact on program performance.
- Use of standard interfaces. This should be used in interfacing the application.
- Code security. In order to avoid commonly known break-in mechanisms such as buffer overflow, SQL injection and the likes.

Nowadays, there are tools which check the validity of the code based on the defined standards, so that it scans through the code and detects noncompliance. It is highly recommended to use these tools as they save considerable effort in checking, and can be given to the project team for them to self-check.

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### 7.13 Test Guidelines

Testing guidelines should specify the type of tests to be undertaken and by which party. Testing has been described already in Chap. 6 and Sect. 7.8 previously. As the types of testing are very much project dependent, specific test guidelines need to be agreed during the project start. Types of testing required may include:

- **Unit testing**—mandatory, conducted by vendor.
- **Integration testing**—mandatory, conducted by vendor.
- **Regression testing**—needed only if change is undertaken on an application currently in production, or if a change is to be performed on an already accepted application (retest). Some amount of testing is to be undertaken by the vendor and O&M, more exhaustive testing by the end-users. If the change is only a technical upgrade or patch, testing may be conducted solely by O&M.
- **User acceptance test**—mandatory, only after the above have been undertaken.
- **Stress testing**—optional, depending on the criticality of the application and feasibility for conducting stress testing.

Details on testing techniques can be found in Sect. 5.5.

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### 7.14 Training Guidelines

Training is many times the make or break for the success of a project, as the project's success depends to a large extent on the acceptance by the users. Training however, is commonly neglected, rushed or is an afterthought of the PMs. It is commonly taken for granted.

As such, training guidelines should be as explicit and detailed as possible. Different trainings should be undertaken for different stakeholders:

- **End-user training.** Main users of the system should be taught how to use the system. This means that manuals need to detail up to the transaction level, complete with screenshots and step-by-step guide on how to transact. User reference manuals also complement these, which is a manual of all commonly used functions and transactions in the application. It is however not enough to teach how to transact; the users must also understand why the process has been designed that way, so that an overview of the process needs to be explained to them. Different end-users will use different transactions, so trainings must be specific for each particular user type.
- **System administrators' training.** Knowledge transfer for the benefit of the O&M TM team. It should enable them to maintain, support, and in some cases reconfigure the applications and infrastructure in the future. It should cover architecture design, network specifications, databases, hardware, configuration, maintenance, and upkeep procedures, and how to maintain the systems' roles and permissions. These are the administrators of the system that will subsequently keep the systems running.
- **Operators' training**—focused towards the day-to-day operations that will need to be conducted by ITOM. They are normally the batch processes used in producing the necessary outputs.
- **Application Management training**—for the benefit of O&M's Application Management team, will cover the overall architecture of the solution, the processes implemented and the rationale for them, the current configuration setup, as well as how to maintain (change) the configurations when future changes are undertaken on the system.
- **Developers' training**—is a discussion on the code utilized for the project. If this is a technology new to the developers then, depending on the contract, should also include the necessary training on the technology. If not part of the contract scope, then the O&M developers shall have to undergo through a separate external training before the turn-over trainings.
- **Overview trainings**—this may be sessions organized for the benefit of those O&M personnel and IT management not directly involved in the project nor in the turn-over but which need to be informed on the general aspects of the project. It shall be a condensed version of the above-mentioned trainings.
- **Train the trainers session**—This will not only consist of the training material for the final end-users, it is also more elaborate in explaining the processes, and should also contain notes, guides and FAQs that will be used by the trainers in replicating the training. From experience, the more effective trainings are those that “tell a story” and not just give rote pointers on how to do things because people remember better when it follows a story line. This means normally following a process from beginning to end, even if they are not the user involved in all these steps. As an example, it is easier for a maintenance engineer to understand and follow what he has to do when the whole maintenance process

is explained (From planning, scheduling, release of the maintenance orders, fulfillment, completion of the maintenance order details, closing and analysis of reports), rather than just telling the maintenance engineer the different fields he has to fill, the click buttons he has to press, in a mechanical way.

All the trainings that are to be lined-up as part of the project need to be identified in a training plan. This training plan explains the training strategy and includes such details as:

- Type of training
- Recipients of the training
- Estimate on the number of trainees
- Person to conduct the training
- Approach taken for the training (Train the trainors, training of all personnel)
- List of associated material needed for the training
- Point in time the training will be imparted (before going live, during the support phase, etc.)

Reverse knowledge transfers (reverse KT) are also a very effective way to both train trainors as well as verify whether they understood. This method consists of teaching the future trainor on what he has to do, and thereafter asking her to in return teach the trainor that taught her.

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## 7.15 Backup and Recovery Guidelines

Should state when backups are to be conducted, by whom, and the type of backups (see Sect. 6.1) to be utilized. The actual execution of the backup may be performed by the O&M team; however, the project team must trigger the request. A typical point in time when a backup must be conducted includes:

- Upon finalization of the s/w installation
- Regularly for the DEV and QA servers (full and incremental backups as determined by the schedule)
- In case DEV and QA are also being used by O&M, right before any changes are started by the project team.
- Upon finalization of the unit testing (DEV, QA)
- Before the release of the changes into production (PROD)
- Before applying any major patch
- Upon acceptance of the patch

Recovery can be initiated in case of major failures which can neither be fixed or take too long to revert without initiating a recovery procedure. If it is in an environment also handled by O&M, PM must necessarily seek O&M's approval.

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## 7.16 Pre-go Live Guidelines

These will encompass many of the points discussed in Chap. 6, which are needed as part of the cut-over plan. Pre-go live guidelines will normally include the following:

- Approved cut-over plan
- Approved data migration plan
- Successful data migration sign-off—in case it must be executed before go-live.
- UAT completed and accepted
- List of manuals and other materials to be used by the users and O&M in support
- Preparation and briefing for the first and second level support teams
- FAQ for the Service Desk personnel
- Full backup
- Pre- and post-go live checklist. This is a checklist as prepared by Technical Management that indicates the condition of a resource, application or function before and after the release. It is used to verify that the release was successful, by comparing it to the pre-release condition, which should either match, or if not, have an acceptable reason for the discrepancy. It is the first check after completing the releases to make sure that these were successful.
- Password change test—it is crucial that O&M's Technical Management group be handed over the new password. As such, they should test that it can be changed without problem, even before going live
- Operations Manual
- Acceptance by O&M of Knowledge Base from project team
- Advisories to users. Indicating any downtime, as well as informing them of the new releases.
- Go/No-go signed decision by the CIO

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## 7.17 Post-implementation Support Policy

As explained as well in the cut-over Chap. 6, post-implementation support should be agreed-upon by both parties at the start of the project. Warranty for any hardware shall be processed by the project vendor (if procured through them) if any incidence occurs during the project.

Regardless of who actually conducts the first level post-implementation support, O&M or the vendor, any defects and incidences detected during the contracted period of post-implementation support is the responsibility of the vendor. That means that even though first level support was for example, already transferred to O&M, if they are unable to resolve the issue, it now escalates to the vendor for resolution. The policy should be clear in that all tickets still OPEN at the end of the post-implementation support phase shall still be resolved by the vendor, even if after the contracted period.

As a practical example, if post-implementation support was 3 months in accordance with the contract, but on day 3 months—1 day, there were still eight incidence

tickets open with the vendor, then these shall have to be resolved by the vendor even after the 3 month period elapses. If this were not the case, then all the vendor needs to do is just sit it out and wait for his contractual period to lapse, without having invested any effort in their resolution.

Other aspects the policy should cover are:

- Required minimum hand-over sessions to the O&M team for the support. O&M team must sign-off its acceptance.
- Turn-over of all manuals and project documentation to O&M
- Turn-over of all Knowledge Base documentation to O&M
- FAQ session and materials to Service Desk operators so as to maximize first call resolution
- Uploading of all relevant documentation to the User support portal
- Formal hand-over and sign-off of first level support to O&M with the sign-off as well from the CIO

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## 7.18 Service Desk Usage Policy

Indicates the manner in which the project team shall be allowed access to the service desk, and how its requests will be escalated. Before the go-live, the project team shall be given access to the service desk for it to file any relevant project requests, just as any user would. After the go-live however, the service desk must be set-up to process incidences and requests in accordance with the warranty support agreed upon, concretely, who will be in charge of first level and second level support as explained above.

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## 7.19 Security Guidelines

Generally follows the security guidelines used by O&M and that for end-users. Additionally, project security guidelines may explain the policy needed for granting remote access to systems. Generally speaking, no PROD access is to be given to project personnel and remote access to DEV and QA should have permissions limited to those modules or transactions strictly being developed. No Super user rights should be given to project personnel unless these environments are their sole responsibility, which should nevertheless be limited to DEV and QA only. More details are discussed in Chap. 10.

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## Further Reading

Harmer, G., 2014. *Governance of Enterprise IT based on COBIT 5: A management guide*. Ely (United Kingdom): IT Governance Publishing.

ISO, 2011. *IOS/IEC 20000-1 International Standard*. Switzerland: ISO/IEC.

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Kunas, M., 2012. *Implementing Service Quality based on ISO/IEC 20000*. 3rd ed. IT Governance Publishing.

Weill, P., Ross, J. 2013. *Executive's Guide to IT Governance: Improving Systems Processes with Service Management, COBIT, and ITIL*. Wiley.

Weill, P., Ross, J. R., 2004. *IT Governance: How Top Performers Manage IT Decision Rights for Superior Results*. 1st ed. Harvard Business Review Press.

Selig, G., 2008. *Implementing IT Governance: A Practical Guide to Global Best Practices in IT Management*. 1st ed. Van Haren Publishing



*Project management methodology gives us the structure and the framework with which to work by, allowing us to replicate our success (or failure! If lessons are not learned) quite easily as we traverse project after project. Needless to say, there is no “one-size-fits-all” methodology when it comes to IT project management. The key is to determine which methodology is more appropriate for a given project. But how does one identify appropriateness? In this chapter, we introduce the Agile project management methodology, and using certain differentiating aspects, we shall compare it vis-à-vis the traditional Waterfall methodology with which it is so often contrasted against, and bring to light some criteria to help determine when such methodology is deemed appropriate.*

*After establishing the differentiating factors between the two project management methodologies, we focus on details on the most popular Agile “flavor,” that is, the Scrum, and how this is operationalized through its different ceremonies and artifacts.*

*The last part of the chapter touches on DevOps and DevSecOps, which, as some say, are natural follow-throughs coming off an Agile(-Scrum) project implementation.*

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## 8.1 Introduction to Agile and Basic Concepts

Since its conceptualization in 2001, Agile has significantly gained momentum and popularity, especially in most recent years with the proliferation of mobile applications.

At its core, Agile’s fundamental principles can be summed up into the following:

- **The What:** Agile’s focus is on delivering customer satisfaction.
- **By Whom:** By Agile’s self-organizing and collaborative team.
- **Through How:** Through Agile’s iterative and sustained delivery, with much allowance to flexibility and change.

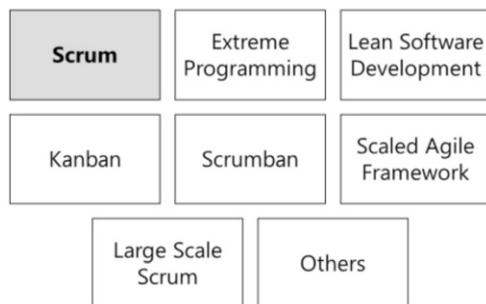
To detail further, below is the Agile Manifesto (Highsmith 2001):

1. Our highest priority is to satisfy the customer through early and continuous delivery of valuable software.
2. Welcome changing requirements, even late in development. Agile processes harness change for the customer's competitive advantage.
3. Deliver working software frequently, from a couple of weeks to a couple of months, with a preference to the shorter timescale.
4. Business people and developers must work together daily throughout the project.
5. Build projects around motivated individuals. Give them the environment and support they need, and trust them to get the job done.
6. The most efficient and effective method of conveying information to and within a development team is face-to-face conversation.
7. Working software is the primary measure of progress.
8. Agile processes promote sustainable development. The sponsors, developers, and users should be able to maintain a constant pace indefinitely.
9. Continuous attention to technical excellence and good design enhances agility.
10. Simplicity—the art of maximizing the amount of work not done—is essential.
11. The best architectures, requirements, and designs emerge from self-organizing teams.
12. At regular intervals, the team reflects on how to become more effective, then tunes, and adjusts its behavior accordingly.

Note that there are in fact a lot of specific methodologies of Agile, which are often referred to as Agile flavors. As shown in Fig. 8.1, these are the common Agile flavors, and each has distinct characteristics which may render one as better suited over the other in a given development scenario. Regardless of some of their distinctions however, Agile's fundamental principles as discussed above remain as their common denominator.

In keeping focus in this book, we shall direct our attention to Agile-Scrum methodology, which is widely regarded as the most popular Agile flavor. To present more clarity, it is best that I differentiate Agile-Scrum vis-à-vis the more traditional

**Fig. 8.1** Common flavors of Agile



Waterfall project management methodology, from which prior chapters of this book have been based on. The differentiation between the two project management methodologies is shown in Table 8.1.

For this reason, software and applications that need constant updating and enhancement are good candidates for using Agile-Scrum methodology. Nowadays,

**Table 8.1** Waterfall vs. Agile-Scrum methodologies

Criteria/aspect	Waterfall	Agile
Delivery phases	Linear, sequential, one-pass approach. Each phase of analysis, design, development, and testing is done sequentially one after the other, before the eventual implementation. In most cases, a formal sign-off is required before one moves to the next phase.	Iterative approach, with phases done multiple times in a miniature scale. Phases of analysis, design, development, testing, code fix, and sometimes even up to implementation, are done repetitively. The ensuing software product is refined further in each succeeding iteration.
Emphasis	Exhaustive planning and design, with complete documentation. In most cases, sign-off is required to “seal” the agreed requirements and design.	Focus is on the output, that is the working system application. Changes to the requirements are welcome and accommodated in future iterations.
Project team composition	No limit as to the size of the project team. Depending on the project, may need to on-board various people.	Small in size. 10–12 members maximum.
Team role assignment	Roles and assignments of team members are clearly defined at the start of the project. Each brings forth a particular skill set into the group, which defines his project role (e.g., developer, system architect, QA tester, business analyst, etc.)	Each member chooses one’s own tasks, and whose completion he then commits to. Any one member of the development team can do the whole cycle: design, develop, test, and fix.
Team dynamics and business people participation	Business people may be consulted and tapped on <i>specific phases</i> of the project.	Collaboration between business people and developers is <i>on a daily</i> basis all throughout the project.
Product validation/testing	Business people or product owners are only able to validate the product after the development completion, during user acceptance testing. Subsequent changes will bear additional costs.	Business people or product owners are able to validate the product in its early working stages, in fact for each iteration, thus allowing possible improvements in the next iteration that would bring more value into it.
Release criteria	Upon test acceptance to ensure compliance of the software product to the signed-off requirements and design, the software is ready for release.	Upon determination of the business that there is already a “minimum viable product” after an iteration, the software is ready for release.

there is an expectation for newer versions of software to be released often, popularized especially by apps. Agile-Scrum's promise of a fast implementation for the salient functionalities that bring most value to customers, delivered by a self-organizing and collaborative team, makes it an appealing methodology for both business and development team alike. On how exactly it can deliver this promise shall be discussed in detail in the next sections.

## 8.2 Basic Components

As with any IT development project, Agile-Scrum starts with (1) the project objective and (2) the project team. The project objective dictates the resulting application, feature, or enhancement that the project aims to deliver. At this point, high-level scope of work that just defines what application or feature is to be developed that is of course of value to the intended users/customers should be sufficient to on-board the project team.

It is up to the project team, specifically the “product owners,” to identify and prioritize the detailed list of functionalities that the development team should include in their development, and it is worth noting that this list is a work in progress and is often subject to, and should be allowed to, change and be refined as the iteration progresses. This flexibility after all is one of the core characteristics of an Agile methodology. It is then the “scrum master” that ensures that the Agile principles are adhered to at all times during the course of the project.

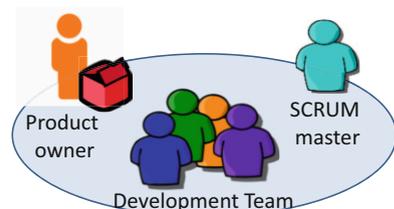
These three, *the product owner, the development team, and the scrum master*, comprise the typical Scrum team as presented in Fig. 8.2.

Given the high degree of collaboration expected in all Agile methodology, it is worth emphasizing that these three roles are very much involved from start to finish, and in all activities in between.

### 8.2.1 The Product Owner

The product owner wears two hats: that of the business and that of the potential or target customers or end-users.

**Fig. 8.2** Typical Agile-Scrum team



Representing the business, the product owners are the domain experts who, with their specialized skills and know-how, identify what can bring value to the product and, taking it a bit further even, what can ultimately differentiate the product from all others that are available in the market. That being said, there may be instances when representatives from other departments may become product owners too—and not just the process owners or system champions—in order to represent other stakeholder’s interest, such as in the case, for example, of involving sales and marketing or business development team to become part of the product owners, as their knowledge of the market competition and other similar software offerings (in the market) can greatly contribute to the overall design of the system.

On the other hand, in its representation of potential users or customers, the product owners should reconcile what the best practices are with what will be of greater ease, usability, and practicality from the end-user’s perspective, in its development of features and functionalities of a software.

The responsibilities of the product owner are as follows:

- They are the owner of the product backlog (as explained in Sect. 8.2.5). She breaks down the high-level scope of work or project objective defined at the start of the project into details. The product owner does this through the “product backlog” which lists all the intended features and functionalities of the product, and it is from this list that the product owner likewise prioritizes their order of development and delivery based on what they believe would be of highest value to the customers.
- Establishes the acceptance criteria for the product or its feature or functionality. These acceptance criteria should be well communicated to the development team for their guidance.
- Validates and tests the product against the set acceptance criteria. To ensure timely feedback and immediate identification of possible noncompliance to set criteria, the product owner conducts this validation not one-time, but frequently alongside each development iteration, which is known in scrum as a “sprint” (see Sect. 8.2.4).
- Executes the final integrated or end-to-end testing of the product or solution before the official release or shipping to potential clients or customers.
- Additional responsibility may likewise include the development of product materials such as fact sheets and user guides, as well as the conduct of product demonstrations, especially if the product is intended to be sold to external customers.

### 8.2.2 The Development Team

The development team in Scrum is small in number, and usually made up of just 5–9 people, 10 being the most. Apart from its relatively small team size, below are other distinguishing characteristics of the Scrum development team:

- **Multiskilled team members (developers)**

Each team member can do the entire cycle of “design, code, test, and fix” by himself. There is no one specific task or skill which only one team member can perform, thus eliminating bottlenecks, dependencies, and waiting time.

- **Self-organized**

Any developer can select whichever task he intends to commit to and accomplish. This promotes self-accountability. With one’s chosen task (selected by nobody but oneself) coupled with the developer’s complete set of skills to design, code, test, and fix, the developer has full control in his pacing and deliverables, which leads us to the next characteristic.

- **Owner of the sprint backlog** (as explained in Sect. 8.2.6).

As developers have full control of the tasks they have chosen to complete, all pending tasks whether caused by delays (carryovers from previous development iterations or sprint) or valid backlogs waiting for the next sprint, are their responsibilities.

It is best emphasized that this sprint backlog is a shared responsibility among all developers. In the spirit of collaboration and again of self-organization, there is an expected trust among the development team that each is motivated and does his significant contribution for the team to complete all sprint backlogs in the most efficient manner.

### 8.2.3 The Scrum Master

In a Scrum team, we can say that the scrum master is the enabler and promoter of all things agile. It is his responsibility to ensure that all team members adhere to, and do not stray from, the Agile values and principles.

The scrum master does this by facilitating various activities that are very particular to Scrum, which are called “ceremonies.” There are five specific ceremonies facilitated by the scrum master in Agile-Scrum, and these are the sprint, sprint planning, daily scrum, sprint review, and the sprint retrospective (Lockhart 2023). We shall touch on these ceremonies in succeeding sections as we discuss the operationalization of Scrum.

The scrum master likewise guides the process owner and the developers in creating the different Scrum “artifacts.” Scrum artifacts are the tangible objects that serve as guide in developing the software product. These are outputs prepared, created, documented, or developed by either the product owner or the development team. It is with the scrum master’s expert guidance that these artifacts are assured to contain sufficient details. There are three main artifacts in Scrum, the product backlog, sprint backlog, and product increment (Harris n.d.), and all these we shall encounter in the subsequent sections.

As each of these so-called ceremonies and artifacts is undertaken and created with a specific intention or purpose, it is important that the scrum master not only espouse participation of the team members to these ceremonies, but more importantly, the team members must be made aware of, and repeatedly inculcated with the specific intent and significance of why these ceremonies are carried out in the first place. That

being said, it is often helpful when the scrum master extends a bit far more than the standard Scrum ceremonies, and conducts some “extras”:

- A briefing/overview of the key principles and fundamentals of Agile and Agile-Scrum to the team members as part of the project kickoff, especially if team members are new to this methodology.
- Periodic, informal gatherings of the project team outside and on top of the Agile ceremonies.

These sessions help in promoting greater collaboration, which is key to Agile. The scrum master directs and guides so that the team members become more familiar and build better rapport among themselves.

As one can see, the scrum master sets the agile tone. He does not dictate nor delegate tasks to any of the scrum team members. Agile rests upon the concept of a self-organized team composed of motivated members. Even the bottlenecks and areas for improvement that would fast-track the deliverables are identified by the team members themselves, primarily the product owners and the development team, and not by the scrum master. This is in stark contrast to how a project manager delivers a project via Waterfall methodology, where his delegation and supervision of accomplishment of one’s responsibilities, as well as identification of catch-up plan in case of a project schedule slide, is of foremost importance. The scrum master merely directs the team to realization and facilitates identification of measures to boost the team’s performance.

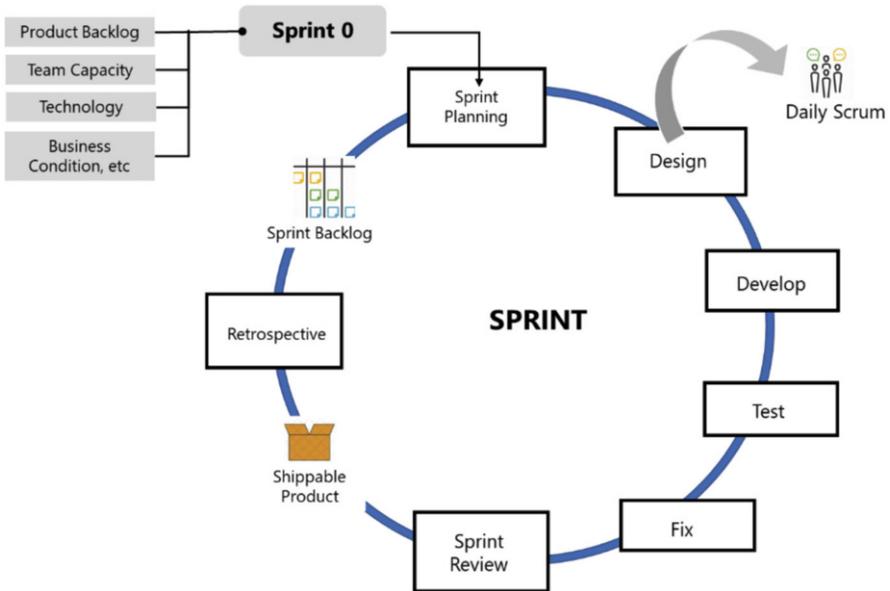


Fig. 8.3 Scrum methodology

Now that the scrum team has been organized and on-boarded on the high-level project objective and deliverable, the scrum team is now ready to engage in the actual development project following the scrum methodology as encapsulated in Fig. 8.3.

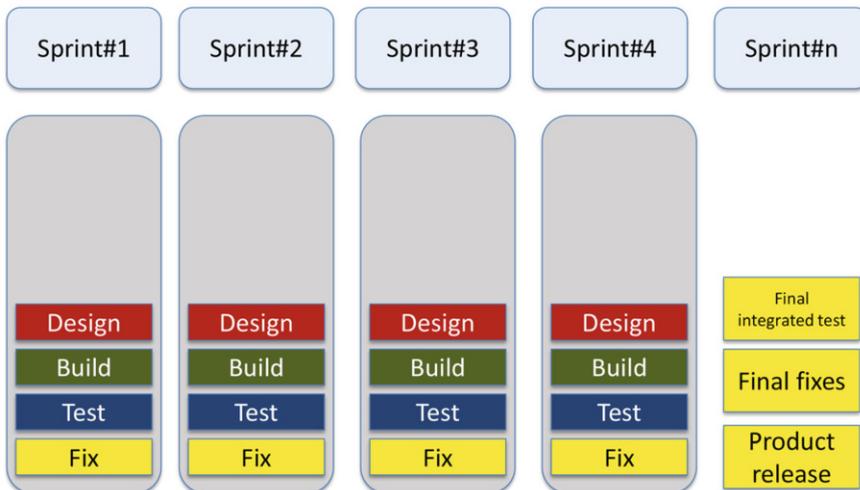
As shown in Fig. 8.3, the different ceremonies and artifacts previously mentioned define the Scrum methodology. Before we go into the details on how this Scrum methodology is operationalized via these ceremonies and artifacts, it is best that we familiarize ourselves first with the concept of a **sprint**, which, as rightfully shown in Fig. 8.3 is the core of Scrum methodology.

### 8.2.4 Sprint

A sprint is a time-bound activity, usually from 1 to 3 weeks, where miniature phases of software development from analysis, design, development/coding, testing, fixing, and even some simplified documentation are all conducted and completed.

The main purpose of a sprint is to be able to deliver a working feature or functionality at its end. To put it simply, the sprint is the development **iteration** we so often referred to in prior discussions, the scaled-down software development iterative process. Several sprints comprise an Agile-Scrum project, all contributing to a working feature or functionality that will ultimately build a “shippable” product as illustrated in Fig. 8.4.

Each sprint comprises of a design-build-test-fix iteration for a slice of the software being developed, plus the Agile-Scrum ceremonies described before. The entire software is therefore developed by developing multiples of its parts iteratively.



**Fig. 8.4** Sprints leading to final product release

Before the scrum team is able to deep-dive into the development cycle starting with its very first sprint however, the product backlog must first be defined.

### 8.2.5 Product Backlog

A product backlog shows the list of all the intended requirements for the software product to be developed, including its features and functionalities. As mentioned above, it is the product owner who lists down all these detailed requirements and functionalities and thus, is the owner of the product backlog. This product backlog is documented in the form of “user stories.”

For large software development projects, the identification of requirements often starts with “epics” as these are much easier to list down and which immediately sets the tone for development. Epic often translates to modules and/or submodules within a software application as shown in Fig. 8.5 for a sample Customer Billing System development project.

In Fig. 8.5, the product owner started with the high-level identification of what modules (Administration Management and Customer Management) and submodules would comprise the Customer Billing System; these are the so-called epics. A high-level description and requirements specifications are also indicated, as these will then be developed and refined further into detailed user stories. As soon as these are listed, epics are then ranked based on development priority, from most to least important. Ranking the epics also helps in prioritizing the user stories to be documented and firmed up, so as not to cause any bottlenecks and idle time during development. As one may observe in the latter part of this section, developing and writing a user story entails complete and accurate details so that the development team can understand and follow.

Once epics have been identified, it likewise makes it easier for the business to visualize and develop the product roadmap, especially if it intends to consequently develop an enterprise application solution such as that illustrated in Fig. 8.6.

Epics are then broken down into detailed user stories. User stories are created to be as small enough as possible but still of use or value, in order to be possibly completed in one sprint.

Continuing with our example for the Customer Billing System development project, the Administration Management module → User Management submodule is ranked with priority 1. However, it is not granular enough to be completely developed within, for example, a 2-week sprint (assuming here our sprint lasts 2 weeks) period. Thus, it needs to be further broken down and detailed into the level of specific facility and functions as illustrated in Fig. 8.7.

From Fig. 8.7, the “Maintain Users” facility should allow its users to create, modify, deactivate, and delete user accounts (4 functions). Each of these functions will correspond to the lowest level user story documentation as illustrated in Table 8.2.

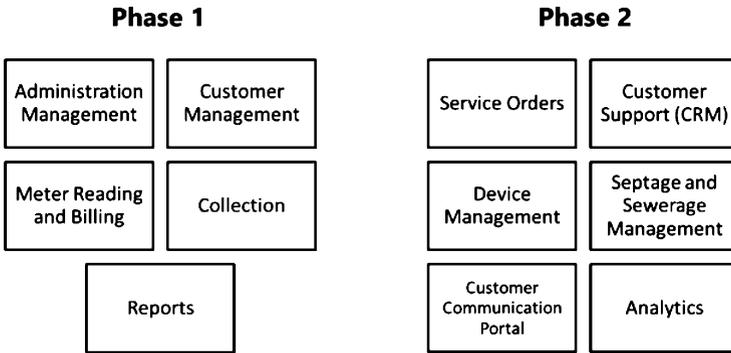
As Table 8.2 demonstrates, for user stories to be effective in guiding the development team, they should contain the following details:

EPICS		Requirement Specifications	Rank/ Priority
Module	Sub Module	Description	
Admin Management	User Management	<p>A facility where the system administrator user may be able to perform the following functions:</p> <ul style="list-style-type: none"> <li>-Users</li> <li>-Maintain Profile</li> <li>-Maintain Department</li> <li>-Maintain Company</li> </ul>	<ul style="list-style-type: none"> <li>▪ Only the System Administrator will be able to access this facility.</li> </ul> <p style="text-align: center;">1</p>
	Master Data Maintenance	<p>A facility where users can create, update, and deactivate list values for entities/tables.</p>	<ul style="list-style-type: none"> <li>▪ Only the System Administrator will be able to access this facility.</li> <li>▪ The System Administrator can add, update, and deactivate values from each list.</li> </ul> <p>Process Specifications</p> <ol style="list-style-type: none"> <li>1. Adding Values - when users want to add new list values, this will be requested from System Administrator</li> <li>2. Deleting Values - list values cannot be deleted, only deactivated if no longer required to be part of the dropdown items.</li> </ol> <p style="text-align: center;">2</p>
	Meter Reading Rules Maintenance	<p>A facility where users can create, update, and deactivate meter reading rules.</p> <p>Rules defined under this function shall serve as the basis for consumption computation.</p>	<ul style="list-style-type: none"> <li>▪ Only the Functional Administrator will be able to access this facility</li> <li>▪ The Functional Administrator can add, update, and deactivate meter reading rules</li> </ul> <p style="text-align: center;">14</p>

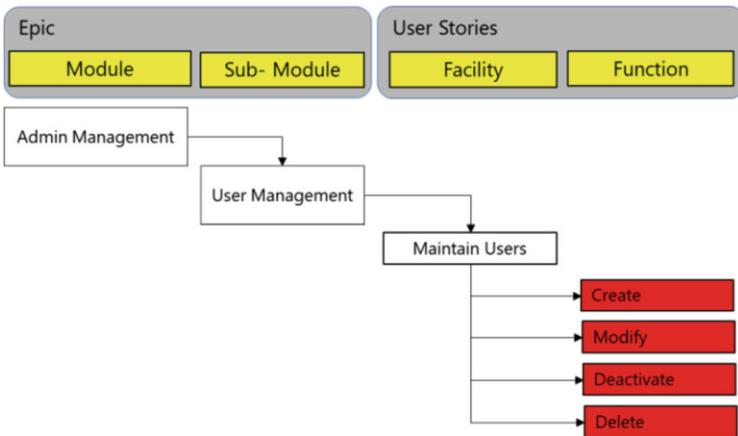
**Fig. 8.5** Epics showing the modules/submodules of a Customer Billing System development project

EPICS		Requirement Specifications	Rank/ Priority	
Module	Sub Module	Description		
Customer Management	Customer Data Dashboard	<p>A facility which will serve as the central page for performing all transactions related to Business or Technical master data. From this page, the user may be able to search, create, and update Business or Technical master data.</p> <p>Business Data Includes the following:                      -Business Partner                      -Contract Account</p> <p>Technical Data Includes the following:                      -Connection Object                      -Premise                      -Installation                      -Device</p>	<p>▪ The Customer Service Representative will be the primary user of this facility.</p>	3
	Business Partner Management	<p>A facility where users can create a Business Partner, through single or massive.</p> <p>A Business Partner is a prospective client which may eventually apply for a water service connection.</p>	<p>▪ The Customer Service Representative will be the primary user of this facility.</p> <p>▪ The Customer Service Representative can create a Business Partner through 2 ways: single or massive</p> <p>▪ For massive creation, the facility will require the user to upload an excel file (with specified format) in order to perform the massive creation of Business Partners.</p>	4

Fig. 8.5 (continued)



**Fig. 8.6** Enterprise solution roadmap showing epics for a Customer Billing System



**Fig. 8.7** Illustrative scope breakdown from epic to user stories, facilities, and functions

- Who is the expected user of the facility.
- What should the user be able to do in that facility (function).
- The expected result of the user’s action.
- The acceptance criteria. The acceptance criteria should already be written in such a way that the developer can already visualize the system navigation, that is, the keystrokes, the expected screen layout, the notification pop-ups, and even the error messages.

All these preparatory activities we have defined so far, the scrum team on-boarding as we all as the product backlog creation, constitute what is sometimes referred to as “sprint 0.” Other project fundamentals which are likewise identified and established during sprint 0 are as follows:

**Table 8.2** Example of user story for user maintenance—user creation

Admin module		AS A	I WANT TO	SO THAT	Acceptance criteria
user story codename #	US_ADMIN_0001	System Admin	create a user and provide authorizations	user will be able to log in the system using the provided authorizations	<ol style="list-style-type: none"> <li>1. There should be “User Maintenance” under Admin module. When clicked, it should redirect to the “User Maintenance” screen</li> <li>2. In the User Maintenance screen, I can see a default view of users with status “Enabled.” The list contains users with the following details:                             <ul style="list-style-type: none"> <li>– Username</li> <li>– Last name</li> <li>– First name</li> <li>– Profile</li> <li>– Team</li> <li>– Status</li> </ul> </li> <li>3. In the same screen, there should be a “Create User” icon. When clicked, it should open a new window where I can fill up the following details:                             <ul style="list-style-type: none"> <li>– Username</li> <li>– Last name</li> <li>– First name</li> <li>– Password</li> <li>– Profile</li> <li>– Team</li> <li>– Status</li> </ul> </li> <li>Field validations and business rules should follow the Admin—User Maintenance profile tab specifications in Business Rules.xls</li> <li>4. In the new window, I can see the following actions buttons:                             <ul style="list-style-type: none"> <li>– Save</li> <li>– Cancel</li> </ul> </li> <li>4.a Save allows me to save the created record</li> <li>4.b Cancel allows me to cancel saving of the record</li> </ol>

- **The technology to be used**
- **The architecture to follow**
- **The standards and guidelines to adhere to**

These may include the development or coding standards, security guidelines, QA or testing protocols, release strategy, approval process and escalation, among others.

- **The sprint duration**

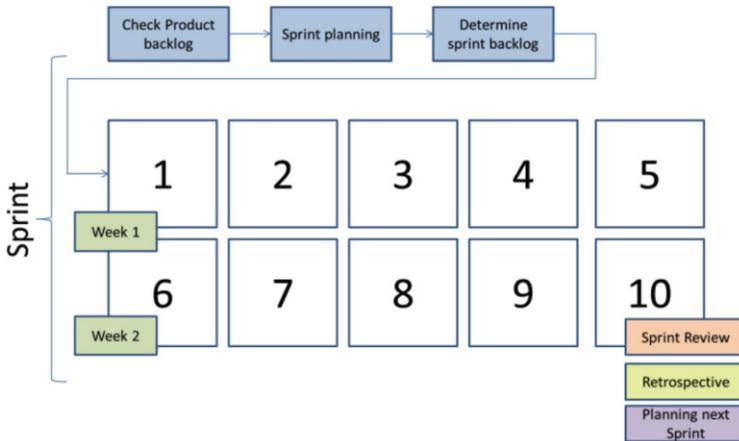
The main consideration is how small the features or functionalities can be broken down into while still having a value or a degree of usability in itself; this will then be the basis in determining the expected length of time to cover the entire design-build-test-fix process and, thus, the sprint time-box.

Once determined and agreed upon, the same time-box shall be applied consistently throughout the project in all succeeding sprints.

- **The Entity Relationship Diagram (ERD)**, the high-level logical data model, will also be typically established at this point.

Note that this is termed as “sprint 0” because in the true essence of sprints, no product or increment thereof that is of value is delivered at this point. Sprint 0 may also take an undetermined amount of time, and will not follow the official sprint time-box duration.

After sprint 0, the scrum team is now ready to start with its first official sprint. Take the example shown in Fig. 8.8 for a 2-week sprint. It shows the different ceremonies carried out within the sprint and are further discussed in the next sections.



**Fig. 8.8** Sample 2-week sprint

### 8.2.6 Sprint Planning

All sprints start with the product backlog as reference for its sprint planning. Sprint planning is conducted in two parts, first is the identification of what needs to be developed, and second is determining how these are to be achieved.

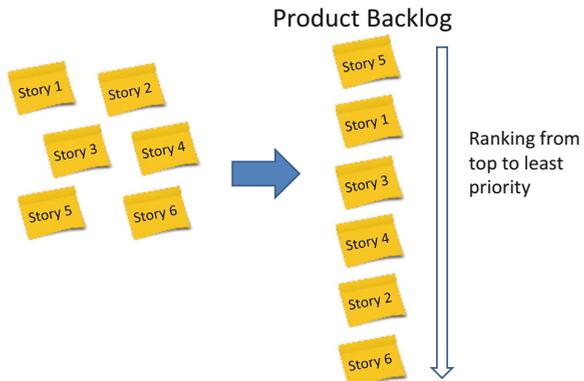
During the first part, the product owners determine which among the items in the product backlog should be prioritized for development. Each of the user stories is ranked accordingly, at this point as evaluated only by the product owner, which is depicted in the illustration in Fig. 8.9.

Top-ranking user stories are then identified as *potential* scope for development in the current sprint. It is *potential* because these identified user stories will need to be subjected to another round of estimation, this time including the development team, before being firmed up as the final scope for development. This estimation, which is done via user story points, rationalizes whether or not the prioritized sprint goal user stories are indeed achievable or not.

Story points are relative weights assigned to user stories based on the perceived complexity of the requirement, uncertainty of details, or even risk of non-completion. The scrum team may adopt any point system they deem appropriate whether quantitative (e.g., point system of 1–5 where 1 is the lowest and 5 being the highest) or qualitative (e.g., standard sizing measure of small, medium, large). What is important is that the scrum team agrees and has a common understanding of the relative weight associated with each point. It is often helpful to come up first with a Story Point Matrix, an example of which is in Table 8.3 (Altexsoft 2021).

Both the product owner and the development team must agree unanimously to a story point for each and every user story. There are several techniques and exercises

**Fig. 8.9** Product backlog ranking



**Table 8.3** Example of a Story Point Matrix

Story point	Task complexity	Requirements clarity	Amount of effort required
1	Low	Poor	Minimum effort
2	Medium	Good	Moderate effort
3	High	Excellent	Maximum effort

that facilitate user story point estimation and alignment such as poker planning, dot voting, bucket system, and the like (Do Async n.d.).

Story points for the user stories planned for the sprint are then added up. Based on the total story points, addition or removal of user stories from the initial priority list may happen. This recalibrated list shall now be the *final* user stories committed for the sprint. Additionally, this user story point system facilitates velocity tracking (see Sect. 8.3) and better planning for succeeding sprints.

With the final sprint goal user stories unanimously agreed upon, the next step is to determine how these are to be fulfilled. It is at this point that the selected user stories are broken down and assigned with measurable tasks and estimates. Tasks to be completed are identified for each user story by the development team. Estimated effort based on man-hours is also defined for each task. This reaffirms whether or not the user stories identified per sprint are doable or feasible.

Table 8.4 shows a sample task list for the Customer Billing System-User Maintenance-Create User Facility user story.

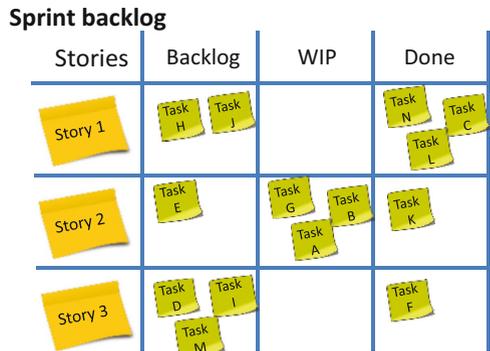
This task breakdown listing per user story as developed by the development team is what we call the **sprint backlog**. In a scrum board, the sprint backlog shows at one glance all the user stories lined up for development, and the tasks needed to be done for each user story to be completed as shown in Fig. 8.10.

If the current sprint is already a succeeding/incremental sprint, it is likewise during sprint planning that sprint backlogs from the previous sprints are reviewed and determined if these are to be included in the next sprint goal.

**Table 8.4** Sample tasks list

Tasks	Effort (h)
Design user interface	2
Create user interface	4
Create API	4
Unit testing	2
Test design	1
Test pass 1	2
Test pass 2	2
Update of working documentation	1

**Fig. 8.10** Sprint backlog on a SCRUM board



There are already different software tools available for documenting, collaborating, and monitoring product backlog and sprint backlog. Examples of these are Trello, Asana, Jira, and ActiveCollab, among others.

### 8.2.7 Development

This is the actual design-code-test-fix cycle undertaken by the development team to complete the committed user stories. It is during this activity that the development team goes into full self-organizing mode, that is, each developer chooses the specific user stories and tasks that each commits to deliver.

During development, the acceptance criteria for each user stories guide the development team in their activities. Inasmuch as the acceptance criteria are expected to be as complete and as visually descriptive as possible, the product owners are expected to be always available to answer any further clarifications that the developers may have.

With this open collaboration, it is not unusual that changes to user stories and their acceptance criteria may need to be undertaken even at this point. As one of Agile's principle is advocating flexibility and adapting to change, such changes may be allowed but only for as long as the development for that specific story has not yet been started and story points for the resulting changes are the same as the original count. This will ensure that this will have no significant impact causing delay in the sprint commitments.

### 8.2.8 Daily Scrum

The daily scrum is a short daily touchpoint meeting held literally standing up by the scrum team. This should not go beyond 15 min, and while everyone is invited even those outside the scrum team, only those with direct commitment to the ongoing sprint may talk and participate. This means that the development team and, to some extent, the product owner are the ones participating. The scrum master, as usual, directs and facilitates the daily scrum.

Each developer or product owner takes turns doing a quick personal retrospect and affirming one's commitment in front of everyone, by answering the following guide questions:

- What did I accomplish yesterday?
- What will I do today?
- Is there anything preventing me from completing my tasks?

This is done daily in order to consistently check the scrum team for its focus. Note however that this is not a status update for the scrum master, nor a venue for requirements clarifications with the product owner.

### 8.2.9 Sprint Review

At the end of the actual development activity, the sprint culminates with the sprint review.

The sprint review is a session where the development team presents the working product or feature/functionality based on what has been committed during the sprint planning. This is an informal and a very interactive session, attended not only by the scrum team but also by other stakeholders. No formal presentation is prepared but instead, an actual walk-through or demonstration of the working system/product or feature. Emphasis is given to the word “working,” which also means “completed” such that only those completed user stories are presented during sprint review. Any user story with even just one of its tasks pending is not considered “done,” rendering the product or feature “half-finished” and thus, not being eligible for presentation. This, in turn, would then constitute and form part of the sprint backlog.

The product owner validates and confirms if the product/product increment being presented adheres to the acceptance criteria initially set in the user stories. Other stakeholders, especially those coming from the business, are also allowed to give feedback. Any possible improvement based on these feedbacks may be included in the sprint backlog, and may be lined up for the succeeding sprints.

At the end of the sprint review, a product increment is delivered. In simple terms, a product increment is a working version of the software or its functionality. All user stories with their corresponding tasks, done and presented during sprint review, comprise and build into the product increment. Previous product increments from previous sprints roll into the current sprint’s deliverable to come up with the *as of* product increment.

A product increment, inasmuch as it may be in a working or useful state already, may or may not be released, shipped, or sold to external customers yet. This decision rests on the business, as may be represented by the product owners, whether or not a particular product increment may already be considered *minimum viable product (MVP)*. MVP is further explained in Sect. 8.4.

### 8.2.10 Sprint Retrospective

It is conducted usually right after the sprint review. The sprint retrospective is an informal *lessons learned* session among the scrum team, and is oftentimes gamified (e.g., Mad-Sad-Glad, Explorers-Shoppers-Vacationers-Prisoners, Two Truths and a Lie, etc.) (Simic [n.d.](#)) to keep it interesting and constructive.

Through various activities, the scrum team reflects on the recently concluded sprint:

- What did we do well?
- What went wrong?
- How can we further improve for the next sprint?

The sprint retrospective is also a session for recognizing and thanking individual scrum team members who may have contributed exceptionally in the last sprint. The idea is to identify the good and effective practices that made the current sprint successful so that these are sustained in the next sprint, and at the same time identify action items for areas that need improvement.

This session closes the sprint at hand, and the scrum team then gets ready for the next sprint iteration, starting again with the sprint planning.

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## 8.3 Scrum Project Monitoring

As Agile-Scrum allows much flexibility in scope via changes in user stories during sprint planning, how exactly do we keep track of the project's progress?

For the scrum team, the completion of the developers' tasks and the product owners' acceptance of the developed user stories are the most important. Ensuring that these tasks are all done within the intended sprint matters in preventing any sprint backlogs, which will ultimately impact the overall product development timeline. The use of software tools for managing Agile projects allows the team to monitor the sprint and user stories' status, as well as the tasks and their compliance to the acceptance criteria. Figure 8.11 shows an example of such using Trello.

Aside from these online tools, one can also use a **burn-down chart** in monitoring and reporting the status of each sprint. The burn-down chart tracks the scrum team's progress by reporting the tasks or story points that remain to be completed at any moment in time, comparing this with the ideal. The total story points committed for a sprint are the values in the y-axis, while the x-axis reflects the sprint's number of days.

To explain Fig. 8.12, the development team has committed to complete user stories with a corresponding 30 story points in total, over a span of 10 days (1 sprint). The blue line indicates the ideal burn-down progress, that is, the team must accomplish 3 story points each day (30 story points/10 days) within the sprint so that the remaining story point backlogs are evenly spread across the entire sprint.

On a daily basis, the completed story points are checked by the scrum master and are subtracted from the total story point commitment. This indicates the actual remaining story points, and is reflected by the red line. As one can see from day 2 to day 5, the story point backlog is higher than the ideal. The "burn-down" rate of the team, that is, the completion of story points from the backlog, is much lower than the planned accomplishment per day. At day 5, for example, the remaining user stories undone stand at 18 story points, when, ideally, only 15 story points should be left.

A burn-down chart can also be prepared to monitor the progress of the whole project, which is made up of several sprints. This can only be prepared though for a project with a relatively fixed scope, that is, when epics are defined and user stories for the whole project have been more or less identified, alongside their corresponding story points. See illustration in Fig. 8.13.

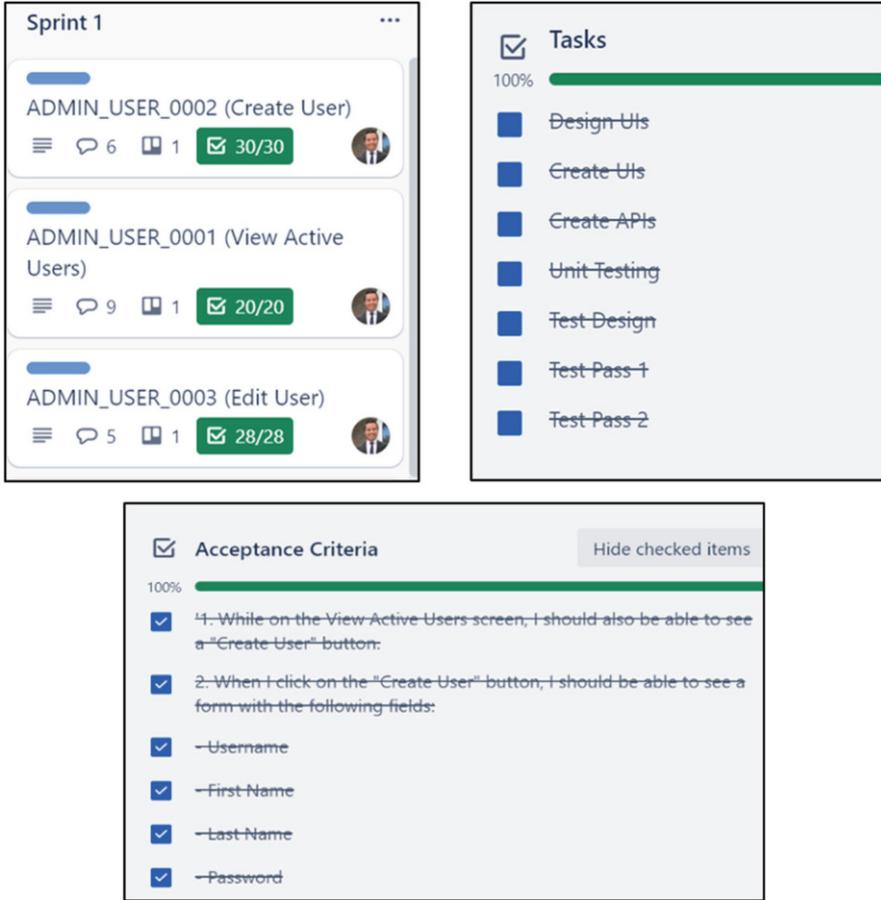


Fig. 8.11 Sample online sprint monitoring board from Trello

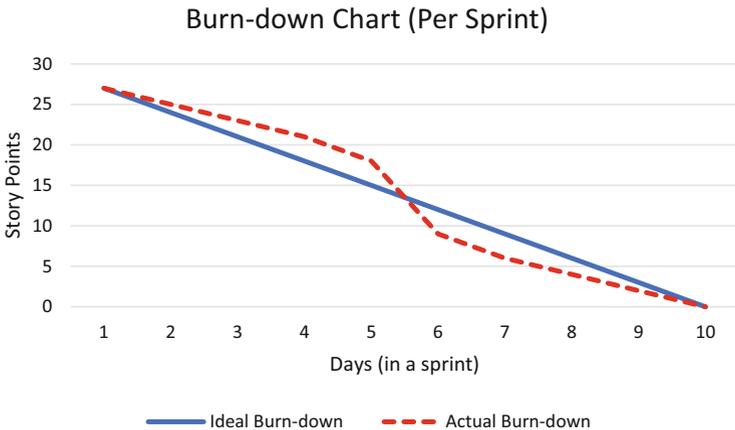


Fig. 8.12 Burn-down chart illustration (sprint)

One may assess simply by looking at Fig. 8.13 that from sprint 1 to sprint 4, the scrum team’s backlog story points are on-track with the ideal. However, from sprint 5 onward, the remaining backlogs are higher than target, before the team rallied up to sprint 10 to complete all pending tasks. There is no indication of what has possibly happened that caused the fluctuations in the burn-down rate. This is where another chart, the **burn-up chart**, may prove to be helpful.

A burn-up chart displays two lines. The first line represents the actual completed user stories (not the remaining stories yet to be burned down) at any given time within the sprint or a project. The second line represents the total story points intended to be completed. We shall take, for example, Fig. 8.14.

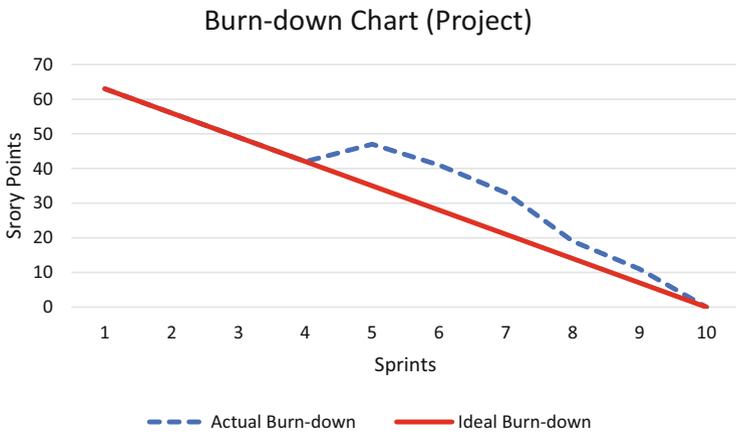


Fig. 8.13 Burn-down chart illustration (project)

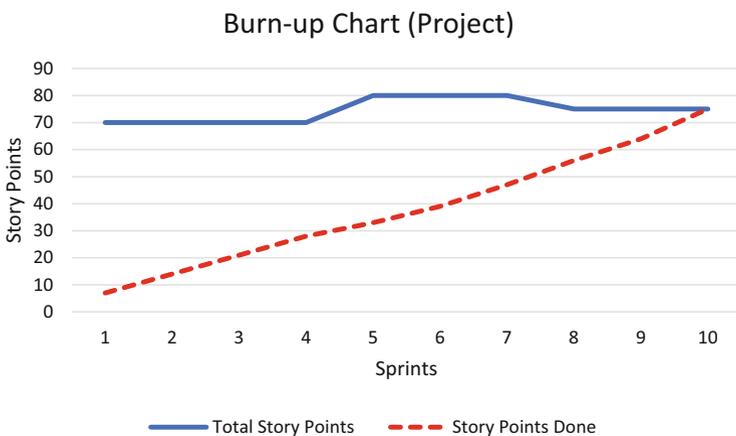


Fig. 8.14 Burn-up chart illustration (project)

Figure 8.14 is in fact representing the same project as shown in the burn-down chart of Fig. 8.13. In this chart, one can revalidate the burn-down chart and see that at the point where the team is seemingly losing momentum with a drop in completion rate (starting at sprint 5), there have been additional user stories incorporated. By sprints 9 and 10, the scrum team was able to have a steady progress, aided as well by some story points being dropped, presumably those “nice to have” stories/features (Taylor 2022).

Velocity is based on actual completion rate of the development team, based usually on story points. This is computed by:

- # of stories completed in a sprint or iteration, or alternatively,
- # of story points completed per day within a sprint

By monitoring the team’s velocity, it allows the scrum team to estimate how much will be completed in the next sprint or iteration, as well as how long it will take to realistically complete all backlogs. Take for example the illustration in Fig. 8.15.

During planning, 6 user stories are to be covered in 2 sprints. For sprint 1, 10 story points over 5 days means that we are projecting a velocity of 2 story points completion per day (10/5).

Planned/Projected				
User Stories	Story Points	Sprint (5 days /sprint)		
US_ADMIN_0001 (Create User)	3	1		
US_ADMIN_0002 (Edit User)	2			
US_WSC_0001 (Create Contract Account)	5			
US_WSC_0002 (Edit Contract Account)	5	2		
US_POS_0001 (Posting of AR)	2			
US_POS_0002 (Reversal of AR)	3			

Recalibrated				
User Stories	Story Points	Sprint (5 days /sprint)	Status	Adjusted Sprint
US_ADMIN_0001 (Create User)	3	1	Done	
US_ADMIN_0002 (Edit User)	2		Done	
US_WSC_0001 (Create Contract Account)	5	2	Backlog	2
US_WSC_0002 (Edit Contract Account)	5		Backlog	3
US_POS_0001 (Posting of AR)	2		Backlog	4
US_POS_0002 (Reversal of AR)	3		Backlog	

**Fig. 8.15** Planned/projected vs. recalibrated user story commitments based on velocity

After sprint 1 however, the actual velocity resulted in only 1 story point per day, and thus by the end of the sprint, only 5 story points were done. This being considered, a realistic projection will push the scrum team to recalibrate the user story commitment for sprint 2, causing additional two more sprints (sprints 3 and 4) to be added into the timeline unless team efficiency is improved or additional measures are taken as part of a catch-up plan. Ultimately this is what really matters to management and the product owners: the timeline for the actual delivery of the application.

For management, progress monitoring is not at sprint level with all the detailed tasks and acceptance criteria, but rather on the overall progress toward the product or product increment set to be delivered at the start of the project. For this purpose, the same essential project management tool as discussed in Chap. 7 can be used. A sample is shown in Fig. 8.16.

The difference here is in terms of what project milestone to monitor. Instead of the sequential project delivery phases used in a traditional Waterfall project, epics can be used for Agile projects. The reason for choosing epics and not sprints nor user stories is that as we have known from previous sections that these last ones may be modified, increased, or dropped at any given point, and so are the number of sprints in order to accommodate these user story modifications, making it hard to have a baseline. Epics, on the other hand, are fixed high-level modules or features set at the very start of the project, which is a good reference point in determining how far the team is from achieving the target product or product increment. Knowing where one's status is, through the completion of the epics, will allow the management/business in deciding if the minimum viable product is already achieved and if indeed ready for release. MVP is explained further in the next section.

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## 8.4 Minimum Viable Product Release and Closing

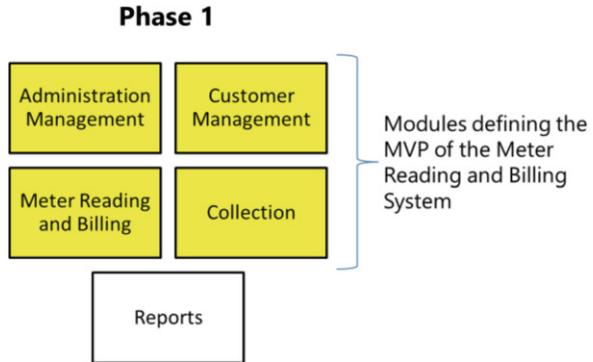
The term *minimum viable product* coined by a Management Consultant, Frank Robinson, in 2001, means that a software product already has the minimum features and functionalities that will bring essential value to the customer or user (Graffius 2018). When this is reached, the software may already be released, shipped, or sold to customers for their early adoption or use. This can also signify the closing of the scrum project.

At the very last sprint, final integration testing is conducted by the product owners or other identified lead testers, and final bug fixes are rendered prior to the release of the MVP to production or to the customers. In our Customer Billing System development project example, it achieves minimum viable product status when the core modules of Administration Management, Customer Management, Meter Reading and Billing, and Collection have all been completed as shown in Fig. 8.17. Succeeding feedback from the pilot implementations and early adopters then serve as inputs into the product backlog for future product increment development, which can trigger another Scrum development project.

Task Name	%	SPI	Actual Start	Actual Finish	Baseline Start	Baseline Finish
BRS Redevelopment	6%	0.31	Wed 2/15/23	NA	Wed 2/15/23	Thu 4/27/23
Project Initiation	100%	1	Wed 2/15/23	Wed 2/15/23	Wed 2/15/23	Wed 2/15/23
Project Kick-Off	100%	1	Wed 2/15/23	Wed 2/15/23	Wed 2/15/23	Wed 2/15/23
Milestone 2-3 - (20-25)%	6%	0.17	Mon 2/20/23	NA	Mon 2/20/23	Fri 3/31/23
Requirements Gathering	90%	0.9	Mon 2/20/23	NA	Mon 2/20/23	Fri 3/3/23
Design Sprint	90%	0.9	Mon 2/20/23	NA	Mon 2/20/23	Fri 3/3/23
Login Module	0%	0	NA	NA	Mon 3/6/23	Fri 3/31/23
As a Customer Relations Specialist / Officer I should be able to login to access BRS	0%	0	NA	NA	Mon 3/6/23	Fri 3/17/23
As a Customer Relations Specialist / Officer I should be able to Login using Single Sign On to access BRS	0%	0	NA	NA	Mon 3/6/23	Fri 3/17/23
As a Customer Relations Specialist / Officer I should be logout from BRS	0%	0	NA	NA	Mon 3/6/23	Fri 3/17/23
The system must be able to perform session timeout	0%	0	NA	NA	Mon 3/6/23	Fri 3/17/23
Bill Calculation and Readjustment Module	0%	0	NA	NA	Mon 3/6/23	Fri 3/31/23
Admin Module	0%	0	NA	NA	Mon 3/20/23	Fri 3/31/23
Final Preparations	0%	0	NA	NA	Mon 4/3/23	Wed 4/26/23
User Acceptance Testing	0%	0	NA	NA	Mon 4/3/23	Wed 4/12/23
Training and Turnover	0%	0	NA	NA	Thu 4/13/23	Wed 4/19/23
Release to Production	0%	0	NA	NA	Thu 4/20/23	Wed 4/26/23

Fig. 8.16 Sample project management tool monitoring for Agile showing Epic milestones, % completion and SPI

**Fig. 8.17** Customer Billing System—minimum viable product



### 8.4.1 Project Documentation

It is wrong to assume that Agile-Scrum does not require any documentation just because of its emphasis on completing and releasing a working product or its product increment in a fast and frequent manner. The operations (O&M) team will still be in charge of the software after its release to production, and project documentation is important for them to effectively support it as clearly emphasized in previous chapters.

If, in a Waterfall project methodology, completion and sign-off of specific project documentations at identified phases of the project (see Chap. 5 for various types) is necessary, Agile-Scrum is less strict in terms of timing. Completion and final updating of project documentations may already be conducted during the last sprint, in preparation for the final cut-over, product shipping, and release to production, and these are as follows:

- The **product backlog**, with its detailed documentation of user stories, which serve as the user/business requirements documentation. The final product backlog should reflect the final user stories and specifications which were developed and adjusted during the course of the project sprints.
- The design documents, which should include both the **functional design document** and the **technical design document**. Chapter 5 of this book indicates the important details that need to be included in each of these design documents.
- Cut-over documentations which include **final integration test scripts, user manuals, operations manuals, and FAQs**. Other specific documentations as well as special turnover procedures to operations may likewise be expected depending on applicability (see Chap. 6 which explains cut-over).
- If the software application is intended to be sold to external customers, **product brochures, fact sheets, and marketing presentations** are also prepared.

## 8.5 Scope-Cost-Quality-Time Dimensions

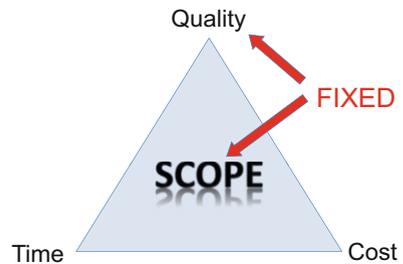
Firstly, let us examine the relationship between scope, quality, time, and cost in a Waterfall approach. In such turnkey projects, the scope is fixed and defined at the beginning of the project, and so is the quality by means of standards and other qualifying factors for the deliverables. Time and cost are defined by the contract, but it is the PM's role to manage these so that the project finishes on time and within the contracted cost. He is to manage and minimize delays, project creep (increase in scope), and check if the deliverables are of expected quality while keeping a control of the costs (usually due to the amount of resources committed to the project). This relationship may be represented by a triangle as shown in Fig. 8.18.

Resources assigned to the project are variable. If the project is of fixed cost, then cost overruns are to be absorbed by the contractor; if not, then these are picked up by the client. The challenge in most Waterfall-type projects is to be able to define the scope as detailed as possible in the beginning to avoid misinterpretation which may lead to under- or overestimation of efforts, as well as to define good-quality criteria and standards (usually the task of the portfolio manager, under project governance).

On the other hand, Agile methodologies can start for as long as a general idea of the product or product increment is available; the specific details and nuances are then successively and iteratively defined, together with quality. What is fixed, however, is the number of resources assigned to the project (cost) and the time for the project to finish. This is represented as shown by Fig. 8.19.

Thus, depending on the ability and cohesion of the project team, the scope and quality may change accordingly as shown in Fig. 8.20.

**Fig. 8.18** Scope and the three dimensions for a turnkey Waterfall project



**Fig. 8.19** Scope and the three dimensions for an Agile-Scrum project



**Fig. 8.20** Scope and quality varying in an Agile-Scrum project



This is not a problem because Agile project management is typically applied in projects in which it is fine to release a partial product at the end of the project, for as long as it meets the MVP criteria, and can be compensated by a successive version of the product with more complete features and less bugs. This brings us to the question on the applicability of Agile-Scrum vs. Waterfall project management approaches.

Some of the basic criteria for choosing Agile would then be:

- **Time-to-market is of the essence, while detailed project scope is difficult to define and is not available at the onset.** Usually, the business has a specific release date in mind, with a general idea of the minimum viable product. It is then left to the development team to iteratively develop based on succeeding refinements on the product specifications as defined by the product owners.
- **Availability of product owners.** The high level of collaboration among the scrum team members spells the success of the Agile project. The product owners are expected to devote significant and constant amount of time refining the user stories and on a daily basis, be available at all times to the development team in case of any clarifications. Daily bottlenecks that need quick decisions should also be catered by the product owner, they being the business representatives in the scrum team.
- **Project is development/coding-intensive.** Agile methodology has been developed to improve and fast-track the software development lifecycle in mind, and the sprint's design-code-test-fix cycle is reflective of development projects. Note however that this is by no means a take-all criterion, as not all development projects are well-suitable to be carried out via Agile methodology. To further qualify:
  - **Highly-visual projects as supported by graphical user interfaces.** For an effective feedback mechanism during sprint review, product owners should be able to review something that they can see with a very tangible output. This will also facilitate quick adjustments on the side of the developers in case the visualization is not at par with the product owners' expectations.
  - **On the contrary, no exhaustive formula/computations nor complex business processes.** These types of development cannot simply be rolled out “half-baked,” and there is no such thing as minimum viable product for these. Formula and computations, as well as complex business processes and workflows, are all-or-nothing requirements. The detailed scope for these must first be comprehensively defined and designed, in order to be able to completely develop and deliver something of value.

- **Project scope is allowed to be ill-defined and a certain room for errors/bugs is expected/tolerable.** As made apparent in the prior criteria, there are only certain types of projects with leeway as to allow partial releases, and even some elbow room for errors or bugs. Examples of this are general consumer-market apps. Users have gotten used to the fact that the app, especially in its initial releases, will come with some bugs, and the fixes and additional features will be available in the next releases. In fact, it is often the submitted reviews from the actual end-users that triggers fixes and further enhancements.
- **Homogeneous team composition.** Given that agile projects are better suited for software development projects, the development team is composed of programmers who, as they are expected to be self-organizing, should all be capable of doing the whole cycle of design-code-test-fix in a sprint. This is in contrast to commercial off-the-shelf (COTS) implementation projects where coding may only be a small portion if not none at all, as most of the scope of work requires functional configuration and business process and domain knowledge, then team members are required to specialize, usually by module: finance, procurement, HR, and also by technology: Java, .net, etc. It is hard for team members to act collaboratively in picking up tasks from the scrum board as by design, they have very different skills. Their skills in the project will also be called for during very specific points during the project.

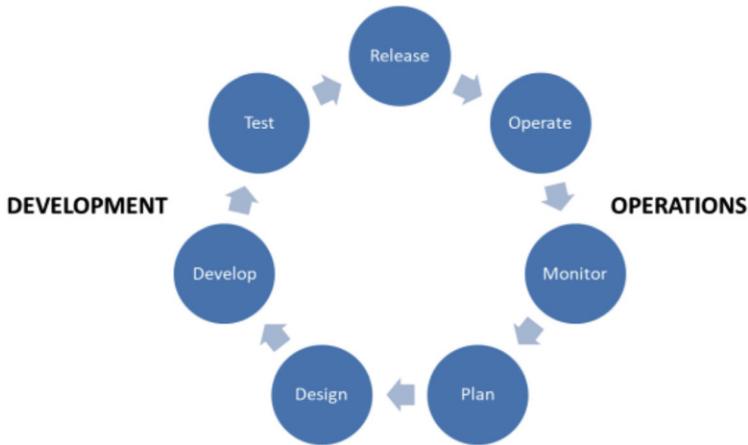
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## 8.6 DevOps and DevSecOps

DevOps stands for Development-Operations, which combines the involvement of both the project and operations (O&M) teams, while DevSecOps is the same plus IT Security (ITSec). As Agile aims to address and work on the limitations presented by a highly structured Waterfall methodology by advocating quick development activities via short, iterative sprints, there is still no guarantee that the resulting product or product increment is released timely and smoothly into production (Courtemanche 2021). In fact, it is actually more frequent to see delays in the releases, if not put on hold all together, because of operational aspects not covered during the design and development activities and O&M, who shall eventually take over the support of the product once live in production, does not accept and approve of the release. DevOps aims to address this concern.

As the name implies, DevOps brings together Development and O&M into the software development cycle. It is not to suggest that tasks and responsibilities are made unclear and overlap between the Development Team and O&M Team; instead the main purpose is to promote collaboration between the two in a continuous plan-design-develop-test-release-operate-monitor cycle as depicted in Fig. 8.21. DevOps aims to secure O&M's buy-in and approval of its development by ensuring the latter's involvement early on, such that timely release and smooth transition to production are assured.

The O&M team will still be in charge of the software after its release to production, while the Agile project team is still responsible for development, but



**Fig. 8.21** DevOps cycle

by having O&M involved early on before the release to production, release and approval should be smoother as O&M's concerns and feedback have already been taken into account during planning-design-development. This is especially relevant in scenarios where the software releases are to happen in rapid succession, and feedback from previous releases can be put in back into the development via O&M's feedback, ensuring that the next release is better, and less buggy.

### 8.6.1 DevOps Key Principles

Unlike Agile-Scrum, DevOps does not have uniquely identifiable components and prescribed ceremonies. As a starting point, it capitalizes on what Agile has achieved in terms of faster development turnaround time. As a further improvement, the collaboration it espouses between the development team and the O&M team is a continuous engagement. Rather than the usual onetime system go-live and hand-off to O&M, DevOps is an ongoing concern that involves the following (Hall [n.d.](#)):

- **Rapid and continuous development.** While it may not necessarily follow all of Agile's methodologies, the use of backlogs and sprints in DevOps allows for manageable development scope that will facilitate rapid and continuous development. What is noteworthy in this backlog definition is that inputs and feedback from the O&M team are well considered and form part of the backlog, in addition to the other functionalities that the business end-users require. Additionally, requirements concerning software and information security may likewise be considered in this early stage of planning and development, as will be later discussed in the succeeding DevSecOps section.

- **Continuous and automated testing.** The adoption of sprints in DevOps' continuous delivery facilitates efficient testing activities. With manageable scope, testing is made at the earliest possible time in the development lifecycle. This is what DevOps terms as "shift-left" as you pull testing and other validation activities very near the development stage (the left side) (Mukherjee n.d.). Fast-paced and continuous testing activities for all ongoing simultaneous enhancements and fixes are not feasible if done manually for obvious reasons. Testers, whether the development team for unit testing, the business users and O&M team for functional and regression testing, or even the security team for vulnerability assessment, simply would not be able to catch up. Thus, DevOps necessitates automated testing as much as possible. This allows for repeated test executions, with no risk of leaving out something significant.
- **Continuous integration and continuous delivery ("CI/CD").** As several developers may work simultaneously on different fixes or enhancements to one program or software, continuously committing and integrating one's code into the main code (shared) repository is one of DevOps principles. This frequent integration is important in order to detect as early as possible any inconsistencies among the various developers' works (Pittet n.d.). Developers working in siloes and in each of their local repositories contradict the CI principle. Continuous delivery, on the other hand, is the packaging of the software in its final or near-final version, rendering it ready for any eventual release to any environment. This readiness is significant as this is what DevOps is all about, to be able to transition from "fast development" to "fast delivery" without delay.
- **Continuous monitoring and feedback.** Once the product, fix, or enhancement has been released to production, the DevOps lifecycle does not end. Rather, it is expected that O&M continuously monitor the software utilization and immediately report back to the development team any bug or issue, whether functional or nonfunctional (e.g., performance slowdown) in nature. These feedback and incidences will then trigger the backlog planning and development cycle in DevOps yet again.

### 8.6.2 DevSecOps

In the face of greater and more sophisticated threats and vulnerabilities, as well as risks to data privacy and data security, DevSecOps brings in yet another team during development, the IT Security team (ITSec) into the software development lifecycle.

Traditionally, system and information security concerns and adjustments in terms of the security posture of applications are only made after threats and vulnerabilities are already identified in production or shortly before its release. Essentially, DevSecOps makes the IT Security team part of the "go-live approval" team together with O&M. Thus, as their buy-in and approval likewise makes or breaks the upcoming PROD release, it is but important that the security aspect is embedded in all stages from planning, design, testing, and up until the continuous monitoring and feedback (more of this in section 10.15).

Hence, it is important that:

- During the continuous planning and development, security policies and guidelines which should include secure coding standards and prescribed control measures and audit trail facilities are communicated early on to the development team for consistent compliance and application as they do their coding activities.
- During the continuous testing, security testing and vulnerability scanning should also be undertaken. The shift-left principle should likewise be applied for security testing, and these must be done as early and as often as possible during development. As such, automating these scanning activities is equally important.
- Once in production, both the O&M and security team continuously scan and monitor the released software in production for any vulnerability by way of periodic checking of logs and security-related alerts, periodic audit activities, conduct of penetration testing, and vulnerability scanning. Amidst the evolving security threats, it is not unusual that fixes and enhancements with regard to application security are referred back to the development team for the next sprint.

As several IT practitioners say, DevOps (and such is the case as well for DevSecOps) is a natural progression from Agile. The two are complementary, and in fact, DevOps and DevSecOps will only be effective if an Agile methodology is adopted for its development activities. What is clearly apparent is that these methodologies are trying to resolve the perceived limitations of their predecessors. It is also equally important to realize that the latest methodology is never a one-size-fits-all solution. The factor of appropriateness and applicability should always be considered while being cognizant of its limitation so one can manage and mitigate accordingly.

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## Further Reading

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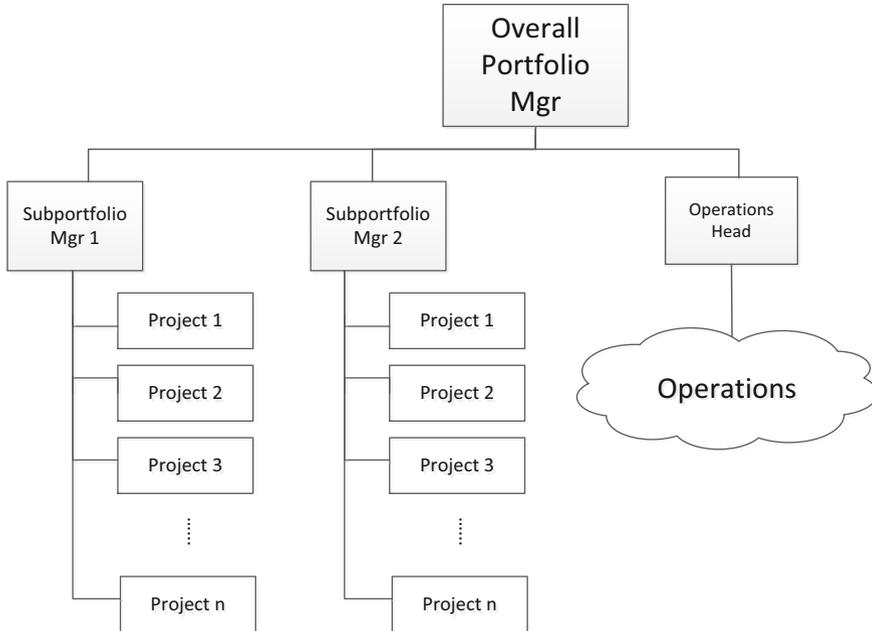
*A Portfolio sits above Operations and Projects in an IT organization. It encompasses all IT operations and projects that are being undertaken by the IT organization in a concerted and coordinated fashion. In order to do so effectively however, a methodology must be in place. As such, we introduce the basic lifecycle of a portfolio: portfolio planning and design, assessment and communication, and rebalancing. On top of this lifecycle sits portfolio governance as well as monitoring and control. Each is discussed separately in detail.*

*Portfolio planning and design refers to the process creating and defining a portfolio and its different components. It must be pointed out that the ultimate portfolio manager in an IT organization is the CIO, and it is she that conceives the creation of the portfolio components, assigns resources and assets and is ultimately responsible for them and their design. Portfolio components may also have interdependencies between them (projects leading to other projects), so that these may also be managed using Project Management Software tools.*

*Portfolio assessment and communicating phase refers to the manner in which the portfolio components will be measured for relevance in an organization. Traditional measures used such as IRR, NPV, etc. work for more tangible projects and portfolios, however for IT, it is hard to come up with such measures, such that it is really intangibles that become part of their assessment. A technique on how to “measure” these intangibles is illustrated by means of causal relationship to company objectives. Lastly, it is important that these measurements be communicated to the different stakeholders on a regular basis for them to understand the progress.*

*Portfolio rebalancing refers to the reprioritization of components and reassignment of their resources, definition of new, and termination of existing portfolio components due to the ever-changing strategy and priorities and of the organization which defines in turn what IT components should be prioritized.*

*Sitting on top of all this is portfolio governance, which regulates the type of documentation that must be completed for each component, regularity, as well as the*



**Fig. 9.1** Portfolio Manager's responsibilities

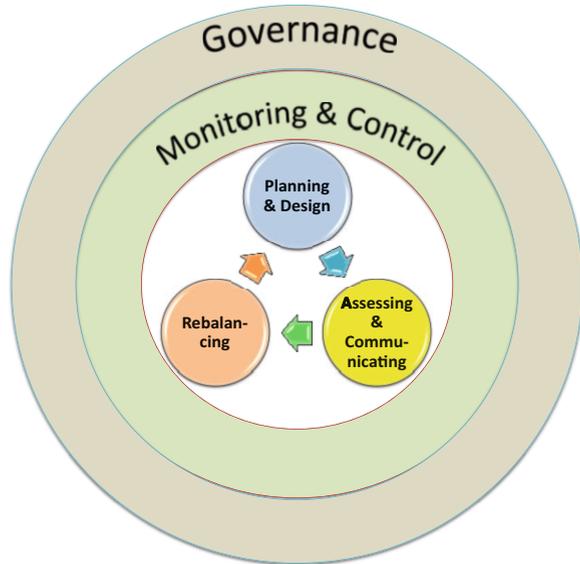
*required management guidelines: releases, change requests, additional funding, and risk registry.*

*Portfolio Monitoring and Control are the regular activities defined by the portfolio manager so as to be able to monitor ensure that the portfolio components are running smoothly, including their alignment to company strategy, timeliness, costs within budget, as well as being able to deliver their intended benefits. It also discusses the different venues and tools used for monitoring and control, as well as the use of PDCA to continually improve this process.*

An IT portfolio would normally be thought of as a collection of projects which need to be managed, however, this also normally includes IT Operations. A typical overall structure is shown in Fig. 9.1.

In this diagram the overall portfolio manager may be the CIO, while the sub portfolio managers either divided by clusters handling different sets of projects by volume and complexity, by type of project (such as finance related, sales related, etc.) or by technology (software vs. hardware/infrastructure). For all purposes, these sub portfolio managers shall have the same function and roles as the overall portfolio manager save for the fact that they do not handle operations. For the remainder of this chapter, I shall therefore not make any differentiation between portfolio and sub portfolio managers, with the understanding that their roles and responsibilities are similar. The IS and II heads are in fact the (sub)portfolio managers for applications projects and infrastructure projects, respectively.

**Fig. 9.2** Portfolio Management lifecycle



In their entirety, all of these different sub portfolios and operations require and compete for different resources, such as:

- Human Resources
- Tools and applications (may be limited due to licensing restrictions)
- Hardware (Servers, network bandwidth, storage)
- Funding

Therefore, some of the main questions that need to be answered by the portfolio manager are:

- How do I assign resources across the different components in an optimized manner?
- How do I prioritize?
- How do I measure the different components' performance?
- How should performance be reported?
- How do I manage all these?

IT Portfolio management is different from IT Project Management in the sense that the latter has a distinct start and end, while a portfolio is a continuous process, even when some of its components end, as there are other components that start, and existing components evolve. Its management is therefore a continuous process, which may be represented as that shown in Fig. 9.2.

The three bubbles in the middle show the continuous process of portfolio management:

- **Planning and Design:** wherein the overall portfolio components are defined, and the design of each component defined in terms of scope, resources and assets assigned to them.
- **Measuring and Communicating:** wherein each portfolio component is measured against defined metrics that it has to meet, and this, together with the status is communicated to the different portfolio stakeholders
- **Rebalancing:** wherein the priorities, resources and assets are rebalanced across the portfolio based on the direction company strategy and tactical direction it is taking.

All of these are in turn managed in accordance with:

- **Portfolio Governance:** following the policies and rules in which the portfolio must adhere to
- **Monitoring and Control:** wherein the portfolio manager is monitoring the progress of the different components and applying control mechanisms to ensure governance and targets are adhered to.

---

## 9.1 Portfolio Planning and Design

Generally, the first step involves the creation of a portfolio(s) and identifying their components. These components would have their different Project Managers or Operations Managers identified. Among the different aspects that need to be identified for the Portfolio are:

- Portfolio name and description
- Portfolio Manager
- Components: sub portfolios, projects and Operations encompassed
  - Component Name
  - Component Manager (Sub portfolio manager, Project Manager, Operations Manager attached to each component)
  - Scope
  - Resources allocated
  - Tools and assets allocated
  - Estimate Duration

Each portfolio component is then planned accordingly, mapping their dependencies (if any). This may be done using a Gantt chart, which will display the timing and interdependencies of portfolio components (Fig. 9.3):

The attributes for each portfolio component are usually embedded in the project/operations documents themselves, such as:

- **Project charter:** Table of Organization, Scope of Work, estimated duration, tools required
- **Assets required:** which is drafted when the system architecture and their corresponding requirements is defined at the project level, will also be identified in the project or operations plan as to when they are needed in the project.

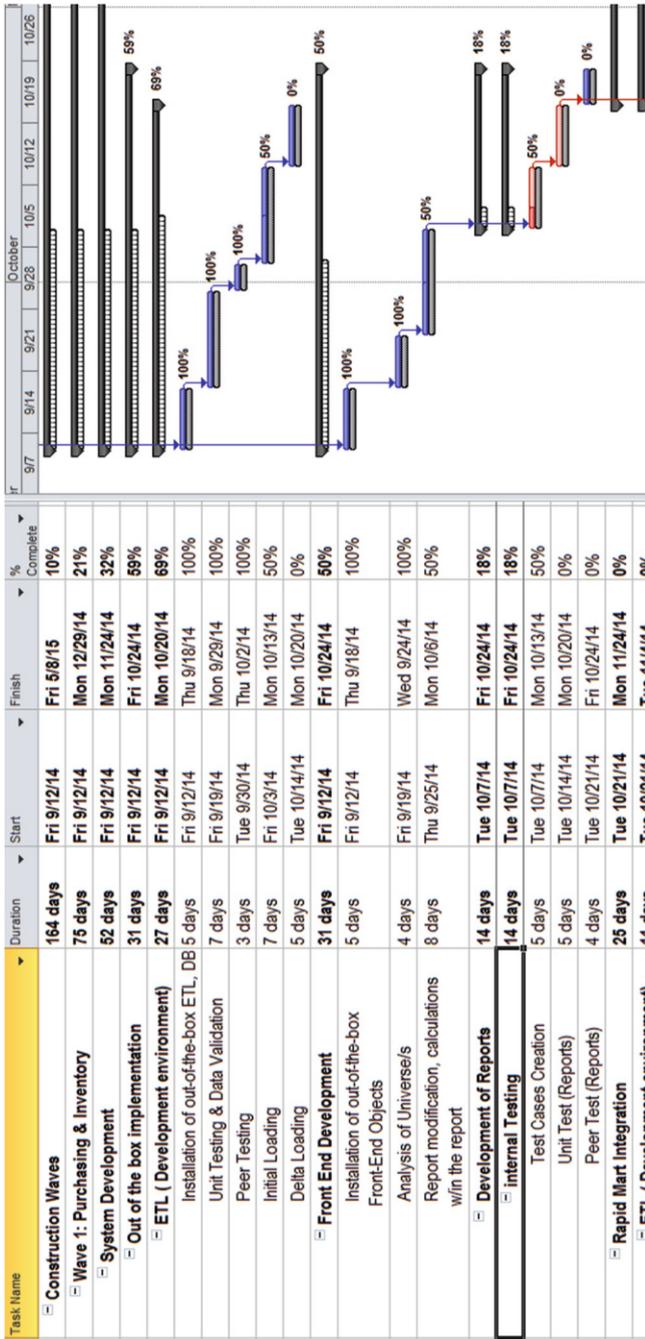


Fig. 9.3 Sample project plan with Gantt chart

- **Assets assigned**
- **Project plan:** includes estimated start date, duration and estimated finish. If project has started, the % completion, as well as the current SPI and CPI.
- **Issues:** as reflected in the issue registry. This gives an idea to the portfolio manager on the status of the component, and if there are delays or cost overruns, the cause for these overruns.
- **Requests:** as reflected in the request registry. These may be valid or not, and their status will be classified by the corresponding project manager. For valid requests, these may be Change Requests (or not), and if so, may or may have a cost implication. Their escalation for approval will follow the policies as per the portfolio governance.
- **Checklist status:** the checklist as defined in Sect. 7.3, gives a list of all deliverables defined for the component. The checklist displays the status of the deliverable, whether it has been attained or not.

The portfolio design and its components will be continuously revisited as part of the monitoring and control and rebalancing operations, as will be explained later on.

---

## 9.2 Portfolio Assessment and Communicating

Portfolios need to be measured in accordance with some metric(s), to ascertain that they are doing well or not. Some metrics proposed by the Portfolio Management Professional Standard of PMI<sup>TM</sup> (Project Management Institute 2013) includes measures like NPV, ROI, IRR, etc. which are very easily understood and measured by management as they have a clear financial impact. This may be well and good for major infrastructure projects, however, for IT projects; it is many times difficult to place a financial return for them. It is however encouraged that, if possible, such financial indicators be used as they will be better understood by higher management, in all other situations, alternative measures will have to be designed.

Traditional measures of component performance are time and cost, however, these measures alone fail to capture the significance of the portfolio component and its overall impact to the organization. Time and cost are measures that are important for the project manager, as they basically indicate how well or problematic his project is running, and many times (though not always) are an indicator of the PM's performance. At a higher level, however, these two measures just by themselves fail to convey much about the project.

Take for example a project that run on time and within the assigned budget, and yet, the project failed to deliver the intended purpose. To give a concrete example, a new payment gateway was put up to allow customers to pay conveniently online, project went well with respect to cost and time, however, because of the design of the interface to the customers, wherein the payment option (that management wanted to prioritize) was not evident to the customers, customers failed to make

(continued)



- Increase usage of online payment; and
- Maintaining Customer Satisfaction via ease of use of the application

Take note as well that the arrows above indicate an influence to, or in the case of the dotted arrow, a weak influence. The relationship is not mathematical at all.

These level 2 objectives can in turn be measured more easily as direct product of the project, the proposed measurements then are:

- Increase usage of online payment:
  - % increase in online payment usage
- Maintaining Customer Satisfaction via ease of use of the application:
  - Customer satisfaction rating should be at least 8 over a maximum of 10
  - 90% of online payments should be processed within 5 min

These indicators can then be measured easily and made part of the portfolio component's objective. See that to attain these indicators, not only technical work needs to be conducted, but most important, alignment to the business, and collaboration with other departments needs to be undertaken during the execution of the project. Ideally, it should also be one of the KPIs to measure the PM's effectivity and form part of his personal scorecard.

During the normal course of the project, progress needs to be reported to the different stakeholders, and this should include:

- % completion
- SPI indicating the % of delay or advancement the project has
- CPI indicating the % cost overrun or delay. If the project is fixed-cost, then cost overruns will be basically due to Change Requests, so these will be reported as additional time delays, plus additional costs to the project (or portfolio, if charged at a higher level).
- Financial indicator chosen (if applicable): IRR, ROI, NPV
- Tactical indicator chosen. This tactical indicator may not make much sense until the project goes live, however, it is expected that the Portfolio Manager handle the component and ensures that these tactical indicators are met, well after the project goes live, as part of his turn-over to operations.

In communicating results, it is important to identify all stakeholders and their particular influence on the project:

- Stakeholder
- Influence/Involvement on the project
- Regularity in communicating results
- Mode of communication

This does not differ so much with what was discussed in Sect. 5.1.9; the main difference is that the concern of the stakeholders and the stakeholders themselves

will change. Most likely, this being a portfolio, stakeholders are of a higher level, and communication can be made less personal (unless particular issues need to be resolved) by means of email with updates, a portal with the uploaded files and updates, and only when needed discussed at steering committee meetings or even management committee meetings.

---

### 9.3 Portfolio Rebalancing

Portfolios are not and should not be static because conditions surrounding it (the business) change constantly, so that a rebalancing of portfolios should actually be part of the normal procedure for managing them. Rebalancing may be due to:

- Changing business strategy of the company
- Reorganization within the company
- Changing availability of Portfolio Assets

First and foremost, the portfolio should be aligned to the company's overall strategy. Failure to do so may result in projects which have no meaning to the company. Projects may be running efficiently (on time, within cost, giving the expected results), Operations handling the different applications efficiently, conducting changes on them efficiently as requested by the end-users, and yet, the projects may be of little relevance to the overall business. The changes and improvements made by Operations may not align as well to the priorities of the company. These portfolio efforts will therefore not be recognized and ultimately fail in their end purpose: that of giving business value.

Generally speaking, company strategy may change over time, so that this has to be evaluated, and the different portfolio components prioritized in accordance with the strategy. Likewise, the company may reorganize, and certain components which may have been important now cease to be. Lastly, the assets made available, whether these are human resource assets, tools, licenses and others change, so that new projects may be possible, or conversely, not feasible due to lack of these assets.

One manner for prioritizing portfolio components may be to rank these in terms of priority based on the overall strategy and organization of the company vs. the required assets. For IT portfolios, it is normally human resources and infrastructure which are the constraint in terms of which portfolio components can be undertaken. The latter is more an issue of budget and lead time to procure, but with the advent of the cloud, this is becoming less of a concern. The former however, qualified Human Resources, is more difficult to address and is commonly the constraint. Take the portfolio shown in Fig. 9.5 as an example.

As may be evidenced by the above, constraints on the resources make the originally planned portfolio timeline impossible to execute. Some alternatives exist:

- Contract resources externally to beef-up the portfolio components. This is possible; however, sufficient lead time for on-boarding may yet be needed.

Portfolio name: Overall IT portfolio	Project Priority	Resource Assignment per month															
		Month 1				Month 2				Month 3				Month 4			
		DBA	Sysad	Java	.net	DBA	Sysad	Java	.net	DBA	Sysad	Java	.net	DBA	Sysad	Java	.net
Operations: support to LOB requests																	
Customer Automatic Debit Agreement	High	0.2	0.5	1		0.2	0.5	1									
Inventory usage reports	High	0.2	0.5	1		0.2	0.5	1		0.2	0.5	1					
Clearing of inventory reservation program	Medium					0.2	3				0.2	3					
Datawarehouse implementation for finance	Medium	1	1		4	1	1		4	1	1		4	1	1		4
HR training module	Medium	1	1		4	1	1		4	1	1		4	1	1		4
Automation of batch processes	Low									1	0.5			1	0.5		
CRM access to field personnel via tablet	High									1	1	1		1	1	1	
<b>TOTAL</b>		<b>2.4</b>	<b>3</b>	<b>2</b>	<b>8</b>	<b>2.4</b>	<b>3.2</b>	<b>5</b>	<b>8</b>	<b>4.2</b>	<b>4.2</b>	<b>5</b>	<b>8</b>	<b>4</b>	<b>3.5</b>	<b>1</b>	<b>8</b>

Portfolio name: Overall IT portfolio	Project Priority	Resource Assignment per month											
		Month 5				Month 6				Month 7			
		DBA	Sysad	Java	.net	DBA	Sysad	Java	.net	DBA	Sysad	Java	.net
Operations: support to LOB requests													
Customer Automatic Debit Agreement	High												
Inventory usage reports	High												
Clearing of inventory reservation program	Medium												
Datawarehouse implementation for finance	Medium	1	1		4	1	1		4	1	1		4
HR training module	Medium	1	1		4	1	1		4				
Automation of batch processes	Low	1	0.5										
CRM access to field personnel via tablet	High	1	1	1		1	1	1		1	1	1	
<b>TOTAL</b>		<b>4</b>	<b>3.5</b>	<b>1</b>	<b>8</b>	<b>3</b>	<b>3</b>	<b>1</b>	<b>8</b>	<b>2</b>	<b>2</b>	<b>1</b>	<b>4</b>

Max resource needed		4.2	4.2	5	8
Available resources		4	4	4	4

- month when project is running

**Fig. 9.5** Sample portfolio showing timeline and resources needed

- Contract the project totally to an external party.
- Reschedule the portfolio components so that the maximum number of resources at any given time does not exceed those available. In this case, it is the lower priority projects which can be delayed, so that higher priority projects push through first. For the schedule above, for example, the Medium priority Operations component “Clearing of inventory reservation program” can in fact be pushed back by 2 months, while the automation of batch processes pushed back by 1 month, resulting in adequacy of resources for DBA, System Administrator (Sysad) and Java roles as shown in Fig. 9.6.

However, the issue of .net programmers is still pending, and since both the datawarehouse and the HR training module projects take long to execute, then there is no alternative but to resort to any of the two aforementioned techniques, in getting external resources.

In all these discussions, there has been no mention of an additional constraint, that of funding. If resources are purely internal, then all costs are sunk costs and portfolio optimization is just a matter of trying to optimize the % utilization of internal resources. If however external resources are needed, then funding should be made available accordingly.

As portfolio balancing is an optimization of several variables: time, funding, go-live, resource availability, and resource competencies, it is generally complex and

Portfolio name: Overall IT portfolio	Project Priority	Resource Assignment per month															
		Month 1				Month 2				Month 3				Month 4			
		DBA	Sysad	Java	.net	DBA	Sysad	Java	.net	DBA	Sysad	Java	.net	DBA	Sysad	Java	.net
Operations: support to LOB requests																	
Customer Automatic Debit Agreement	High	0.2	0.5	1		0.2	0.5	1									
Inventory usage reports	High	0.2	0.5	1		0.2	0.5	1		0.2	0.5	1					
Clearing of inventory reservation program	Medium													0.2	3		
Datawarehouse implementation for finance	Medium	1	1		4	1	1		4	1	1		4	1	1	4	
HR training module	Medium	1	1		4	1	1		4	1	1		4	1	1	4	
Automation of batch processes	Low													1	0.5		
CRM access to field personnel via tablet	High									1	1	1		1	1	1	
<b>TOTAL</b>		<b>2.4</b>	<b>3</b>	<b>2</b>	<b>8</b>	<b>2.4</b>	<b>3</b>	<b>2</b>	<b>8</b>	<b>3.2</b>	<b>3.5</b>	<b>2</b>	<b>8</b>	<b>4</b>	<b>3.7</b>	<b>4</b>	<b>8</b>

Portfolio name: Overall IT portfolio	Project Priority	Resource Assignment per month														
		Month 5				Month 6				Month 7						
		DBA	Sysad	Java	.net	DBA	Sysad	Java	.net	DBA	Sysad	Java	.net			
Operations: support to LOB requests																
Customer Automatic Debit Agreement	High															
Inventory usage reports	High															
Clearing of inventory reservation program	Medium		0.2	3												
Datawarehouse implementation for finance	Medium	1	1		4	1	1		4	1	1		4			
HR training module	Medium	1	1		4	1	1		4							
Automation of batch processes	Low	1	0.5				1	0.5								
CRM access to field personnel via tablet	High	1	1	1		1	1	1		1	1	1				
<b>TOTAL</b>		<b>4</b>	<b>3.7</b>	<b>4</b>	<b>8</b>	<b>4</b>	<b>3.5</b>	<b>1</b>	<b>8</b>	<b>2</b>	<b>2</b>	<b>1</b>	<b>4</b>			

	DBA	Sysad	Java	.net
Max resource needed	4	3.7	4	8
Available resources	4	4	4	4

- month when project is running

Fig. 9.6 Realigned portfolio

requires several iterations until optimality is obtained. Much simpler of course is if all projects are contracted turn-key externally, so that the only internal constraints now become funding and availability of Project Managers/Operation Managers.

As discussed earlier as well, company strategy changes with time, and it is the job of the portfolio manager to be aware of such changes and make the necessary reprioritization of components accordingly. Portfolio components may thus be added, reprioritized in either direction (made more important or less), or dropped altogether.

Take for example a company which prioritized having its own App available for customers to increase on-line sales. This project was allocated funding and resources however, 3 months after the 8 month project started, management found out that even with its current sales channels, severe logistical constraints were hampering the delivery of goods to its customers. Management then decided to initiate a third-party logistics handling program which necessitated an IT component so that it would seamlessly integrate the third party's information with the company's back-end logistics system. After careful evaluation, senior management, together with the portfolio manager decided to freeze the App project and reallocate funding and resources to the new logistics integration project.

As can be seen, rebalancing is needed in regular intervals so as to ensure:

- Portfolio components stay relevant to the company's business strategy and objectives,
- Revised timelines as required by management
- Company Organization
- Resource availability
- Funding reallocation

---

## 9.4 Portfolio Governance

Portfolio governance refers to all policies and procedures which should govern the portfolio and its components. It sits at a higher level than projects and operations, and therefore, both project and operations are necessarily guided by the portfolio governance rules.

As such, both operations and project policies and guidelines must align with the overarching portfolio guidelines. Guidelines would normally cut across all portfolios and be standardized, and would also normally align with general IT policies and procedures as discussed in Chap. 7. Aside from these general guidelines, some guidelines would be specific for the portfolio:

- **Guidelines for officially incorporating a component into the portfolio.**
- **Manner and regularity in which components report their performance.** In this case, and as discussed under portfolio assessment and communication, each component will have its own set of indicators that have been agreed upon with the PM and higher management as those that will be regularly monitored.
- **Portfolio Component documentation.** This will specify the minimum documentation that is required for each project/operation component and is also discussed in Chap. 7. Projects shall have a different set of documentation from operations, so that typical documentation is discussed separately here for each.
  - Project documentation
    - Issue registry
    - Request registry
    - Updated project timeline in standard format
    - Deliverable checklist
    - Risk registry (optional)
    - PM task activity report
  - Operations documentation
    - Operations report
    - Team activity report
    - Ticket summary report
- **Asset request/release guidelines.** This describes the manner in which a particular asset (normally human resources) shall be requested by the PM to be assigned (released) from his project, and includes the approval process.

- **Change request guidelines.** Will describe the procedure for requesting and approving change requests, this shall include all necessary details for the change request including:
  - Reason for the change request
  - Requestor (PM, user, vendor)
  - Scope of work
  - Estimated man-days and breakdown of resources needed for the CR.
  - Cost (if any)
  - Duration
  - Functional and technical details, including any customizations if needed.
- **Guidelines for requesting a change in scope.** Additional scope will be covered by Change Requests, however, from time to time, a change in the scope of the project may be needed due to:
  - Obsolescence
  - Change in the direction of the users/company management
  - Technical limitations
  - Difficulty in meeting requirements, not initially foreseen
  - Reprioritization of scopeThe reasons above should be carefully examined and validated, at it is not good practice to change scope in the middle of the project, however, such possibilities do exist. The change request should include:
  - Reason for the change
  - Requestor (PM, user, vendor)
  - Scope of work changed
  - Estimated man-days and breakdown of resources needed.
  - Impact on project cost (if any)
  - Impact on project duration
  - Functional and technical details, including any customizations if needed.
- **Request for additional funding.** This should be raised by the PM and justified accordingly
  - Reason for the request
  - Amount
  - Reason and Details on the cause for the delay
- **Risk registry**
  - When risk registry should be drafted
  - Procedure and frequency of update

One practical way to monitor all portfolio documentation in a timely manner is through the use of a Document Management System (DMS) in which different folders are kept for the different portfolio components, which are updated in regular fashion (usually weekly). Nowadays many DMS have a web interface so that the documentation is available as a Portfolio portal, which maintains different authorizations depending on the user, as well as approval workflows.

## 9.5 Portfolio Monitoring and Control

The Portfolio Manager is in charge of monitoring and controlling the portfolio. His role is somewhat similar to that of a PM in terms of this function in a project; the portfolio manager must ensure that the portfolio is:

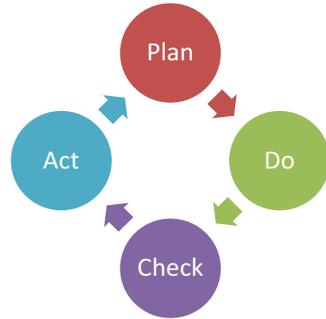
- Aligned with overall strategy, structure and objectives of the company
- Has sufficient resources and other assets assigned to each component so that work can be accomplished on time and with the necessary quality
- Being undertaken on time
- Being undertaken within budget
- Delivering or will eventually be able to deliver its intended benefits

As well as:

- Ensuring that requests from the PM or Operations manager are being evaluated and approved/rejected on time. This includes:
  - Request for assets
  - Request for additional funding
  - Change Requests
  - Changes in scope
- Ensuring that there is no issue which cannot be handled by the assigned PM and his current HR assets. In case the issue is deemed to be beyond the PM's capability, then the portfolio manager needs to step in and facilitate resolution. Typical issues which may need to be resolved by the Portfolio Manager includes:
  - Lack of knowledge by the PM on the issue at hand. This may be technical, functional or a business challenge.
  - Lack of pertinent resource(s)
  - Conflicts between the PM and the users
  - Conflict between the PM and the vendor
  - Mismatch of skills or underperformance by some of the resources assigned
  - Nonconformance with IT, Portfolio, or Project Management guidelines and policies
  - Underperformance by the PM/Operations Manager
  - Delay or non-provisioning of infrastructure
  - Conflict or non-prioritization of task requested by the PM to another team (typically, a request to O&M)
  - Delay in the formal approval of deliverables

The idea of monitoring and control is to ensure that the different portfolio components are running smoothly, and if not, be able to first, detect the issue, and thereafter address the root cause of the issue.

Part of this monitoring and control process includes internal communication between the Portfolio Manager and his Project Managers and Operations Head. Typically these will come in the form of:

**Fig. 9.7** PDCA cycle

- **Operations Meeting.** This meeting should be conducted by the Portfolio Manager, the Operations Head, together with the different O&M Team Leads. During this meeting the operations report is reviewed, tickets and their statistics analyzed, and each team leader given the chance to present his regular operations update. During this meeting, any of these sources of information will be the basis for determining issues and will then be discussed and resolved jointly by the team.
- **Portfolio projects update meeting.** Takes place between the Portfolio manager, sub portfolio managers, the different Project Managers, and if needed, the Operations Head. The latest standard documentation discussed in Chap. 7 is presented, statuses discussed and any issues brought up for resolution.
- **Stakeholders' meeting.** This may actually be the management committee, normally the highest management level meeting, in which all operational, tactical and strategic initiatives are discussed and updates from each department head given. Alternatively, it may be a different meeting altogether, called or regularly held, in which the different portfolio stakeholders are updated on the status. These meetings are normally quick, and focus on:
  - Status of the portfolio components in terms of % completion
  - Project estimated completion dates
  - If delayed, a discussion on the reason for the delays. If issues can be resolved at the stakeholder level, then these are brought up and guidance, resolution or assistance sought.
  - Performance review for operations may include SPI, CPI, summary of cost overruns
  - Discussion on possible strategy change by the company, impact, and rebalancing at the portfolio level

Governance is a common discussion at portfolio meetings between the portfolio manager and his operations head, PMs. This is to review if governance policies are being followed correctly and in a timely manner (such as the filing of Project information), as well as the regular review and improvement of these policies. Review of governance policies will again follow a PDCA cycle shown in Fig. 9.7.

In these review meetings, policies and guidelines are reviewed, tweaked and released again. Any of the PMs and Operations Manager is actually free to come up

with suggestions on how to improve, and these are deliberated and if approved, made part of the guidelines. These should be improvements, not radical deviations of the previous rules, otherwise this will cause consternation.

Another optional component, depending on the complexity and exposure of the portfolio to risks, is to conduct a risk analysis. This is similar to that discussed for projects, in which a qualitative risk analysis can be performed and each risk identified vs. possible impact and probability. The difference here is that this should be conducted at the portfolio level vs. project level. Examples of project level risks are delays in approval from the users of deliverables, failure of a module during testing, or project creep. At the portfolio level these would be risks that can affect one or many components. Examples of this are unavailability of certain resources, obsolescence of some of the portfolio components due to a new direction taken by the company, irrelevance of some projects due to repeated delays in going live.

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## Reference

Project Management Institute, 2013. *The Standard for Portfolio Management*. 3rd ed. Atlanta: Project Management Institute, Inc.

## Further Reading

Unfortunately, there is a dearth of good portfolio management books for IT, below are just some references, though good material is hard to come by.

Sanwal, A., 2007. *Optimizing Corporate Portfolio Management: Aligning Investment Proposals with Organizational Strategy*. 1st ed. Wiley.

Maizlish, B., Handler, R., 2005. *IT Portfolio Management: Unlocking the Business Value of Technology*. 1st ed. Wiley.

Hughes, D.L., Dwivedi, Y.K., Simintiras, A.C., Rana, N.P., 2016. *Success and Failure of IS/IT Projects*. Springer.



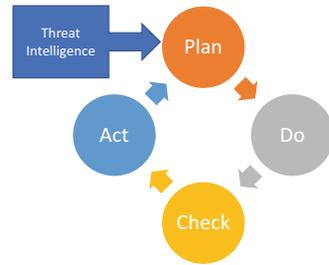
*IT Security has come to the forefront lately due to the huge number of attacks on IT assets, many of them high profile and showing how successful and financially rewarding these can be. Though the basic principles of IT Security have not changed that much, the manner in their application, tools, and operationalization has, due to the ever-changing methods of attack and technology itself. One of the challenges to a newcomer to IT Security is the immense amount of data available out there, dealing with specific security challenges, the problem is really where to start. This chapter talks about the basic architectures, methods, and measures used in IT Security to protect one's assets which will serve as a launchpad to the reader to know where he can further explore and understand.*

*As usual, process, methodology, and policies are essential for the proper implementation of IT Security, as well as the different technology components which are the manifestation of these policies, and all these are discussed.*

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## 10.1 Scope of IT Security

IT Security is commonly mistaken as a purely technical endeavor that needs to be tackled by the IT Security Head or Chief Information Security Officer (CISO), as the case may be. In fact, IT Security touches on every action and setup undertaken by an IT team without exception. It needs to be kept in mind early on, the earlier, the better and the less wasteful and cheaper to undertake. As an example, and as will be discussed later on, software should be designed with IT Security already in mind, rather than having it as an afterthought. It doesn't really start at the design phase, it starts at the planning stage. Developed unsecure software is much harder to fix and costlier too once it is released and operational, rather than having taken into account secure principles of software development lifecycle (SDLC) at the very beginning of conceptualization, design, and coding.

**Fig. 10.1** PDCA cycle

In the same way business analysts are not exempt from understanding IT security practices, not only on the technical side but even in the design of processes as we will see in Sect. 10.4.

Users as well cannot ignore good IT Security practices. In fact, end-users are commonly the weakest link in the security of an organization’s IT assets and are regularly targeted by hackers via social engineering techniques (Fruhlinger 2022; Thomas 2022).

In summary, IT Security should not be a separate domain handled by a separate group within the organization, but is everyone’s responsibility and permeates throughout the organization. The main function of the IT Security Head/CISO is really to develop the policies, techniques, and awareness of these security best practices so that they be practiced accordingly, minimizing the risk of a breach happening, and minimize possible negative impact. She is also tasked with making sure these are complied with.

If we go back to the PDCA cycle discussed in Chap. 4, we can use this and give it a new interpretation in the application of IT Security (Fig. 10.1).

**Plan**—because implementing IT Security measures requires careful thinking, it must be planned accordingly. The most secure practices in IT Security may not be the most practical, or may impact users and operations in a significantly negative way so that a balance needs to be struck between practicality, impact, and risk. Planning the execution is essential in order to minimize any negative operational impact to be felt. At this stage policies should be designed accordingly, as well as operational procedures for the execution of these policies.

**Do**—this refers to actual execution, putting in place the action(s) determined to further secure the organization and its assets

**Check**—ensuring that the actions performed have the desired effect, this of course entails testing at the short term for the actions implemented, as well as audits in the medium term to check for compliance. IT Security policies tend to be complicated, applying not only to one application but, typically, spanning across several IT assets. It is therefore important to check if the entire landscape resulted as secure as it was planned to be in the first place. This comes in the form of log inspections, operational monitoring, internal audits, vulnerability scanning, as well as conducting external penetration tests and the like. It is important because sometimes the risks and vulnerabilities are due to misconfigured, misinterpreted

policies and misconstrued configuration items (CIs), or assets that were forgotten but are still within the perimeter of your organization that remain vulnerable.

**Act**—the result of checking will again feed into the next plan of actions that will be undertaken to further improve the security posture of the organization. This is a never-ending loop due to the changing type of techniques, actors, and vulnerabilities.

**Threat Intelligence**—is information provided by external entities, research, and advisories which provide information on current vulnerabilities, exploits, and ongoing hacks at a global level, which provide additional inputs for the planning stage.

As a general rule, one must remember that any IT Security measure, no matter what that may be, will always have a certain negative impact to operations and the users, be that in the form of additional inconvenience, service downtime, curtailment of rights, additional work, or challenges in understanding the new procedures which many times the users and even IT operations wishes to forego. It is for this reason that a balance must be struck, and IT Security personnel must think that no matter what is put in place, the ultimate goal of the organization is still to be able to continue to operate efficiently in rendering its products and services. IT Security needs to be aligned in supporting that, but of course, making sure it is done in a proper and secure way.

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## 10.2 Policy and Its Relevance

IT Security policy refers to the norms, governance, and guidelines that describe the manner in which IT Security is to take effect in the organization; these span from the policies that govern an IT implementation, to how operations is to function, down to the way the users must use and behave in order to comply with secure practices promoted by the organization.

Though IT Security practices may have commonalities, no two organizations will have the same policies, and these are usually designed in-house based on its organization's functions, perception, and appetite for risk.

As a practice, all security measures adopted by the organization must be documented via pertinent policies, and all policies must also be ensured to be implementable, hence the maxim:

Do not implement a security measure without a policy; and  
Do not define a policy if it cannot be implemented

The first statement indicates that the implementation of a security measure must be documented and clearly understood by the stakeholders, while the second statement indicates that it is no use to put down in writing a measure which cannot be implemented. An example will clearly illustrate what this means.

Take, for example, a security policy which indicates that no files must be extracted from company premises without proper approval. The policy should clearly indicate the scope of this measure, the criteria of what files it is referring to, as well as who shall have the authorization to allow for such an extraction. In order to make this effective and a deterrent toward such behavior, the policy must be clearly disseminated throughout the organization.

On the other hand, suppose that such policy has been defined and disseminated, but that the IT department lacks the necessary tools to ensure that it is followed. It therefore renders the policy useless, and most likely, will not be adhered to by the users.

This shows the importance of policy and its implementation in a practical way.

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### 10.3 CIA Triad

IT Security by the name itself implies protection, but the question is: protection against what? This may be obvious, but it is important to remember that different IT Security policies and configurations put in place defend against different types of vulnerabilities or threats, and some cover several at the same time.

One common reference for this is the so-called CIA triad (Fruhlinger 2020) which stands for:

- **Confidentiality**—only personnel authorized to access information should be able to access.
- **Integrity**—which guarantees the reliability of the data stored in the systems.
- **Availability**—which guarantees that based on the designed SLA the systems, data and infrastructure are available whenever needed.

To better understand the above, let us illustrate them with some examples. In a company, confidentiality is of utmost importance in guarding trade secrets which are the inherent advantage of the company over its competitors in operating. In the same manner, certain internal information (e.g., payroll) should be handled and accessed only by a select group of individuals authorized to do so. Some attacks are perpetrated by external (sometimes internal) actors that desire to access this confidential information for their own advantage. Protecting and guaranteeing that the data can only be accessed by the right people is one of the fundamental functions of IT Security.

On the other hand, integrity refers to the reliability of the data (usually data) that is stored within the organization's systems, in which they may be altered only by the proper authorized personnel, and following its prescribed proper handling. Thus, as an example, financial accounts receivables (AR) data would only be accessible by the Accounts Receivables department, and may only be transacted using the proper finance AR system which has its own process embedded to it, and may not be bypassed. If integrity is compromised, it shall create havoc in the company, leading to possible fraud, inoperability, reputational damage, and even bankruptcy.

Availability refers to being able to access an IT service whenever needed (for as long as within its designed parameters), and not to suffer any access denial due to actors intentionally disrupting the service. A very typical example is that of a website which is normally accessed by customers, a malicious attack can be crafted wherein the attacker creates bots to request information from the website but doesn't proceed in transacting with it, bombarding it with requests so that the web server runs out of resources, and is thus unable to process legitimate requests (i.e., denial of service attack). Another variation may be to attack a company's internal ERP (enterprise resource planning) system encrypting all its data rendering it useless to the organization. Since ERPs are usually the core of a company's operation, this would gravely affect the business as a whole.

Aside from the usual CIA triad, a few more aspects are also important:

- Origin authenticity
- Non-repudiation
- Access control
- Safety

The last two are actually more important nowadays that industrial control systems (ICS) are being integrated to IT systems, and IT Security needs to take into account the specific needs of IOT (Internet of Things) (Dimitrios Serpanos 2018) and ICS (industrial control systems). More of this will be discussed in Sect. 10.18.

Origin Authenticity (sometimes called proof of origin) refers to the ability to ascertain that a transaction is indeed coming from the supposed user/system source expected. This is important so as to know that you are transacting with a legitimate source, whether that is a person or another system.

Take the example of when purchasing some items via a secure (<https://>) public website. Our browser ascertains that the website is indeed the legitimate website it claims to be via the verification of its public certificate, and the certificate's public key is used to decrypt data being sent from the website, guaranteeing authenticity of the website, and a secure connection which guarantees the data's integrity. Confidentiality on the other hand is guaranteed by the use of the client's public key by the website, which is decrypted by the client using its private key. The use of certificates and public and private keys and how they work is beyond the scope of this book, but more information can be obtained in the following references (ISC2 2020; [cio.gov](https://cio.gov) n.d.).

Another example is when a system transacts directly with another, by verifying its security certificate (a common method), the receiving system confirms that the requesting system is who it says it is.

Non-repudiation on the other hand is the inability for a party to deny a transaction it has made. The best example of non-repudiation is in the use of digital signatures in signing contracts: (1) you need to make sure that whoever is said to be signing the

contract is in fact the person he claims to be (origin authenticity); and (2) he cannot later on deny his signing of the contract. This example makes the need for non-repudiation very evident indeed.

If you come to think of it, exchange of certificates, keys, and encryption-decryption using these occurs continuously every time a website, system, or application is accessed, without the users actually being aware of what is happening.

Access control is commonly bundled with confidentiality; however, due to its many ramifications today, I prefer to separate it on its own category. Access control refers to the verification process of a user, further broken down into identity management and access control proper, as explained further in Sect. 10.5. The first is the process of ascertaining who the user actually is (authentication), and the second is granting her with the rights needed for accessing the different IT resources. This affects confidentiality, non-repudiation, and integrity and is a basic component of IT Security. It also has implications on safety and physical security. If access is breached, all of the succeeding aspects may be compromised.

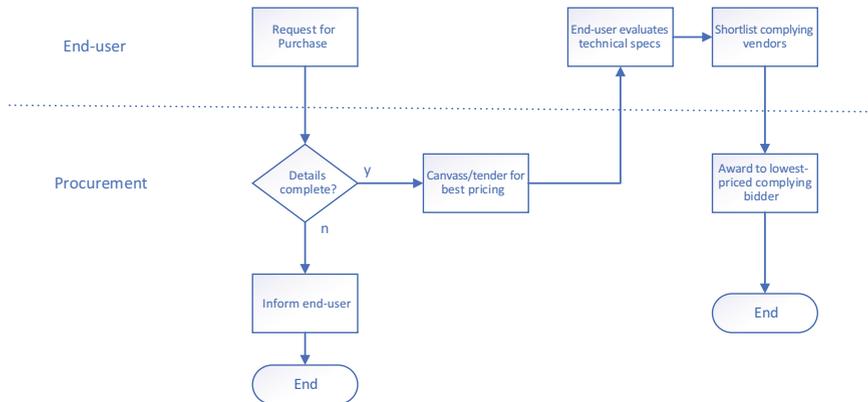
Safety refers to the physical well-being of personnel, as well as equipment. In an industrial setup, a breach can result in destruction of equipment, human harm, or worse, personnel mortality. As an example, imagine an unauthorized access to industrial control systems, in which safety controls are disabled, machinery is put into operation in an abnormal manner, resulting to breakage of equipment, and even personnel injured by it. As one can see, the potential damage in industrial systems is higher than in traditional IT systems and will be further discussed in Sect. 10.18.

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## 10.4 Security as a Process

IT Security is commonly misunderstood as a series of technical tasks that the IT security group is to undertake; however, when transacting and operating IT applications, their underlying processes must be inherently secure for it to be trusted and be of use to the organization. Having said that, processes must be designed to be inherently secure, and must be tested accordingly. To understand this, take the example of a typical procurement process as shown in Fig. 10.2.

As one can see, the procurement process starts with a requestor (end-user) filing a purchase requisition, which then goes through canvassing by the procurement department and once technical evaluation is undertaken by the requestor, ends with procurement awarding to the lowest-priced compliant bidder. Now compare this process with a much more streamlined process in which it is the requestor making the request, herself canvassing, and based on her criteria, awarding the order. The latter is definitely simpler and faster than the former! The inherent problem with this latter process however is that there are no check and balances, and is therefore open to collusion or overpricing. The former process has in place what we call separation of duties, which makes the process safer. This type of design will be encountered endless times again:



**Fig. 10.2** An example of separation of duties: procurement of goods process

- A company's internal business process department authorizing a contract closed by sales
- Payroll information being handled by an exclusive group separate from the finance payments department, even though the latter may be the actual department executing the payment process
- IT Security being implemented by one group, but audited by another
- And so forth

Separation of duties can and should be embedded in the process design of the system to circumvent any possible bypass. Approvals should be made online and logs recorded for each transaction, indicating who transacted and when each step was undertaken.

In conclusion, any IT Security measure has an inherent curtailment of convenience attached to it and for this reason, should always strike a balance between convenience and security. Another way to word this is that a balance must be struck between operations, which is the reason for the organization to exist, and IT Security, which just aims to protect operations, and minimize risk. IT Security measures cannot be implemented unilaterally and without care and without analyzing operational impact. To drive this to an extreme, the most secure organization is in fact the one that undertakes no transactions because it is not allowed to.

Aside from separation of duties, there are other process aspects which need to be taken into account:

- Access control
- Authorization creep

Access control refers to the authorizations given to users in the use of an organization's different computer systems and applications; it goes hand in hand with identity management (as explained in Sect. 10.5). If identity management is in charge of verifying the user requesting access to the system(s), access control is the

one that grants actual access to the different systems, applications, application processes, and data, based on some predefined criteria. There are many different types of access control, among which are (ISC2 2020):

- **Discretionary access control**—as the name implies, this is based on some subjective criteria as determined by the grantor.
- **Rule-based access control**—wherein there is a set of predefined rules defining what access is granted to the requestor, these rules may be based on different criteria including pay grade of the user, physical location, or requestor holding an authorization token. It may be a way to implement discretionary or nondiscretionary authorizations.
- **Role-based access control (RBAC)**—wherein the authorization is based on the role and position of the requestor.

There are also other types which will not be discussed here, but in general, the principle of least privilege should be maintained at all times regardless of the method, which means that the permissions and access given to the requestor should be those minimally needed in order for the requestor to do his (pre)approved duties. No additional privileges and permissions should be granted as these are not needed and may pose a security risk in some cases.

While this may seem common sense, this is commonly easier said than done because of many practical factors that are usually encountered including poor internal processes in the evaluation and granting of access control, convenience (person was given full access as the grantor isn't sure of what the requestor needs), as well as having an incomplete access control granting process defined. An example of this last one is the so-called authorization creep.

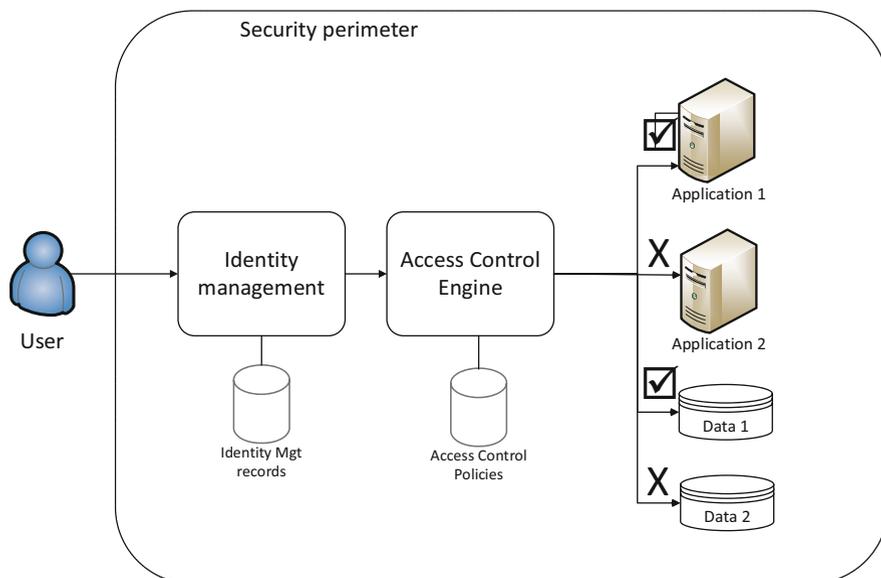
Authorization creep is the gradual but steady acquisition of authorizations by an individual as time evolves. The easiest example that illustrates this would be a user that moves departments within the organization, and as she moves, acquires new authorizations, thanks to her new position, without relinquishing the old. As an example, imagine her moving from the procurement department as a buyer into an administrative position while still retaining her buyer capabilities to release purchase orders to vendors, very dangerous indeed, especially because these rights will most likely not be detected until some incident occurs, or at a later time via an audit.

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## 10.5 Identity Management

Access control as was described earlier determines which IT assets a user may access based on some criteria; however, before doing that, the identity of the user must be verified. Figure 10.3 shows a typical process.

The identity management (IM) engine is in charge of validating that the user is indeed who he claims to be via some verification process. The most common verification currently used is, of course, passwords. Passwords are then verified against the IM's records, and if it matches, then the access control engine is informed of the matching record and details are passed on to it. The access control engine then



**Fig. 10.3** Identity management and access control

checks its records in the form of its access control policies and based on them, grants the user proper access to the different IT assets. Remember that the access control policies may be discretionary, rule-based, role-based, a combination of these or others as the case may be.

Of course nowadays, the use of passwords alone is very risky as hackers have learned to crack these. There are passwords which are inherently unsecure but commonly used or users tend to reuse the same passwords repeatedly. These may be cracked by brute force guessing, password spraying (Mitre ATT&CK 2022) or by hacking an account and using the password to access other systems the user has access to. Strengthening passwords is a must via increasing their length (Microsoft Support n.d.) and strengthening their complexity via embedding numeric and special characters within them, but still these are generally vulnerable, which leads us to the topic of multifactor authentication (MFA).

### 10.5.1 Multifactor Authentication (MFA)

In verifying identities, a proof of identity must be furnished by the user (or external application), and these are called factors. Three types of factors exist:

- **Something the user knows:** such as a password, a secret question, or the like
- **Something the user possesses:** such as a hardware or software token or smart card
- **Something the user is or does:** such as a thumbprint, iris scan, or other biometric

In the example earlier, a password was used to prove one's identity. Since only one factor was used, this is commonly known as a single-factor authentication. Using single-factor authentication solely carries its risks as it can be cracked, mimicked, or broken; thus, the use of a combination of different factor types is preferred and known as multifactor authentication (MFA).

As an example, a user may be logging into a banking website, and it not only requires a password but also a pseudorandom number generated by a software, which is accessed by the user from his mobile device using the bank's official App (also referred to as One-time Passwords). The App generates a number, which, along with the user's password, is entered into the banking website, and only if the two match the bank's Identity Mgt's records is he granted access to the different banking applications within the website. The access grant is based in this case on his banking profile which is checked by the access control engine, checking which products the customer is currently subscribed to, such as savings account, credit card, loyalty system, etc. This access is extinguished after a certain period of time, based again on the access control engine's policy, which will then necessitate the user to verify his identity once more.

Zero-trust architectures (ZTAs) (Jason Garbis 2021) are based on these same concepts as presented in Fig. 10.3; they rely on MFA to ensure the identity of the user and do not assume it. Aside from the regular policies in place, additional rules may be embedded so as to further secure the perimeter; examples of these rule-based access controls are:

- Geofencing: wherein the user must be located geographically within a certain location.
- Time: wherein access is granted only within certain dates and time.
- Concurrency: only one access may be granted at a time.
- Behavior analysis: wherein past behavior using machine learning or AI indicates patterns and disallows access if outside the normal pattern behavior.
- Etc.

Policies should be attuned to the need and applicability of these given the environment in which one works in.

ZTAs have become popular lately due to the propensity of cloud-based applications. In such environments, it is important to verify and grant access to cloud resources based on the minimum rights required and not more. In order to

ensure this, micro-segmentation is used as well (Besser 2020), wherein each cloud resource is in a separate “segment” altogether separated from other segments via a gateway appliance (e.g., firewall), WAF (as explained in Sect. 10.8), or some other means.

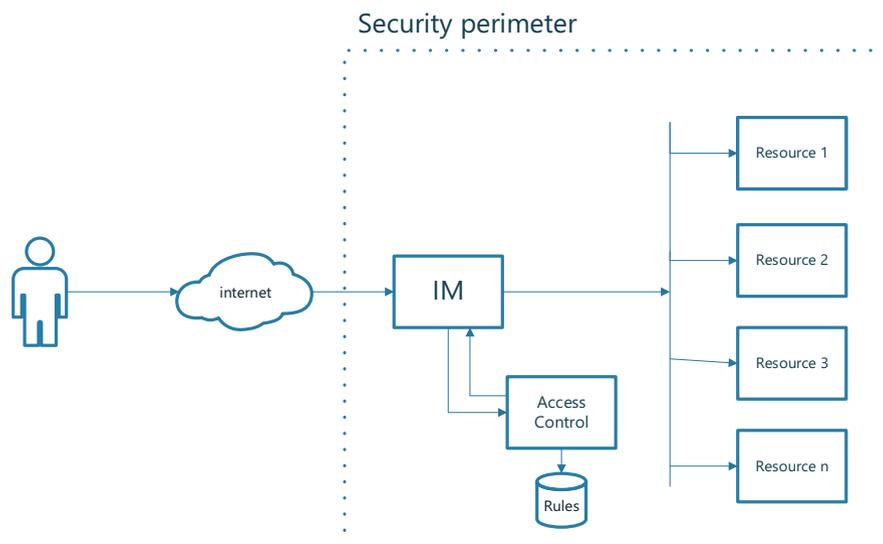
## 10.6 The Perimeter

As seen in Fig. 10.4, network security principles start with the idea of securing a perimeter in which users, servers, and applications would function securely, isolated from the unsecure internet. This concept is shown in Fig. 10.5.

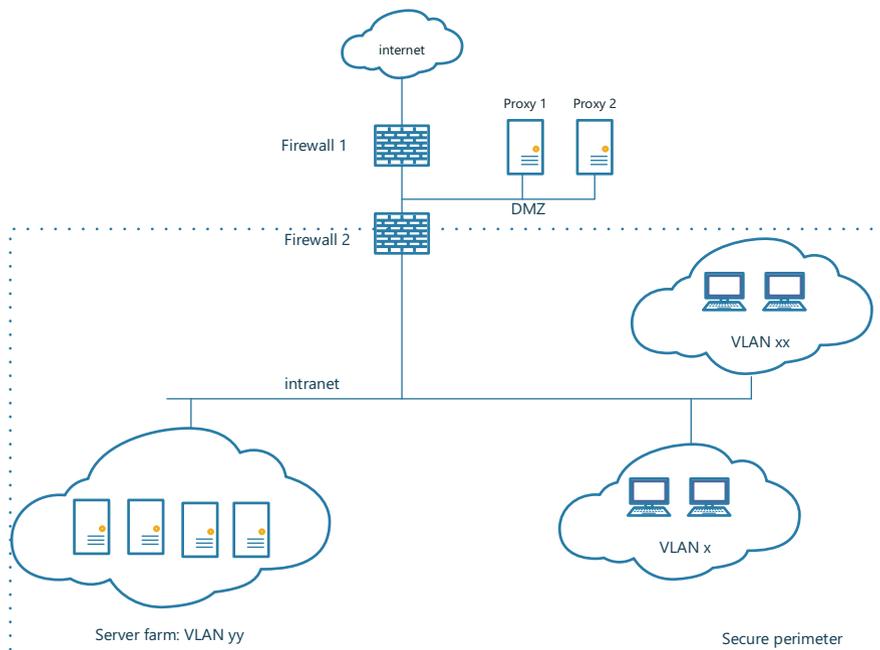
The inside of this perimeter (everything below firewall 2) is called the intranet, and is protected from the Internet by firewalls and other devices/applications that furnish security to the intranet from the outside. For now, let us just think of this perimeter as one secured by firewalls, and we shall expand on the use of other appliances, applications, and modules as we go along.

In this same figure, we can see the so-called DMZ or demilitarized zone, which acts as a buffer between the Internet and the intranet, and is also protected on both sides by firewalls. The DMZ acts as the only area in the network containing servers which are allowed to be accessed directly externally from the Internet by users (incoming connections). The DMZ is then the network segment in which servers facing the Internet are to be placed, for reasons to be explained in a while.

In order to further explain how this general architecture works, it is first important to understand how firewalls work.



**Fig. 10.4** Zero-trust architecture



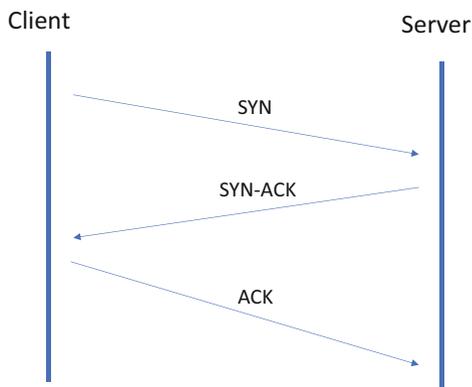
**Fig. 10.5** Intranet secure perimeter

## 10.6.1 Firewalls

Firewalls act as gatekeepers to different network segments, and are in charge of filtering out any disallowed or suspicious traffic. The first firewalls in the market were the so-called packet-filtering firewalls, and basically consisted of appliances with rules on what traffic to allow/disallow based on:

- **Source and destination IP addresses**—either allow certain source-destination combinations or disallow them
- **Type of service**—depending on the protocol, a particular port service connection will be created, say port 80 for HTTP or port 21 for ftp protocols. Particular ports will therefore be allowed/disallowed between specific sources and destinations. Further filtering can be done, allowing only for incoming or outgoing connections (based on who initiates the connection from the point of view of the firewall).
- **Stateful inspection**—blocking by address and type of service is so-called static filtering. Stateful inspection is an additional functionality in which the firewall also inspects each packet in the context of a connection that has been initiated and is ongoing. Thus, in a normal TCP handshake procedure (see Fig. 10.6) in which a Syn request is sent by a client, the reply would be Syn Ack sent back by the server, and the last part of the handshake would be an Ack by the client. The process, explained briefly, is that the client requests something from the server

**Fig. 10.6** TCP connection three-way handshake



(SYN-synchronize), server acknowledges the request (SYN-ACK), and client then acknowledges its reception from the server (ACK) establishing a connection, and then beginning transmission of data to the server. If this sequence is altered, for example, another Syn is sent in place of the Ack by the same supposed client, then the firewall would have the capability to drop such a packet, deeming it out of order and possibly malicious (a typical DOS attack). Other similar scenarios may occur for other packet types.

Let me give here an example of a firewall policy using a pseudo-language just to make it simple for the reader to understand, and merely for illustration purposes. Now imagine a firewall with the following policies in place:

1. Allow **<incoming>** traffic from **<www.google.com>** to **<server1.mycompany.com>** thru port **<443>**
2. Allow **<outgoing>** traffic from **<server1.mycompany.com>** to **<www.microsoft.com>** thru port **<989>**
3. Deny **all other traffic** to/from **<server1.mycompany.com>**

Now if you are familiar with port numbers, we can see port 443 port used by HTTPS, a secure website protocol, being used by the first policy in allowing your server1 to accept an HTTPS connection from Google. The second policy allows a connection using port 989, used by the ftps protocol, a secure file transfer protocol, to be initiated by server1 to the Microsoft site. The third policy indicates that all other traffic, whether incoming or outgoing to/from server1, will be blocked.

Though the pseudo-language used for my example does not actually exist, it gives you a good idea of how firewall policies are typically built.

The current state-of-the-art firewalls go beyond the capabilities described above that are typical of packet-filtering firewalls; in fact they carry many more features used in inspecting traffic such as anti-malware scanning, IPS (described below), and, more importantly, ability to recognize traffic based on application-layer characteristics (OSI layer 7). Thus, not only can we allow/deny access based on

traffic direction, origin and destination, and port used, but also based on the application generating the traffic. Thus for example, if your company disallows the use of Facebook at work premises, a simple policy saying “Block all Facebook traffic” can be implemented. Furthermore, these firewalls understand classification of websites and traffic type, so that the policy may even be more encompassing saying “Block all social media applications” or “Block all violence websites,” and will do so accordingly. They also normally carry virtual private network (VPN) capabilities, which allow users and other servers to securely connect directly to it and access remotely as if they were inside the company’s intranet. Use and setup of VPN is a big topic by itself, and the reader is encouraged to read additional material if he is interested in this topic (Kizza 2009) (and many more material available on the Internet). It is also a fast-changing topic.

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## 10.7 IPS

IPS refers to Intrusion Prevention Systems and as the name implies, were designed to prevent intrusion into a network. The precursor of IPS were the so-called Intrusion Detection Systems (IDS) which would flag suspicious traffic for further action, but these are largely obsolete due to the fact that intrusions and hacking happen very fast and there is a need for real-time response. IPS nowadays come as a service within firewalls which may be enabled. They usually come in bundled as well with antivirus, which scans traffic on the fly and warns and deletes suspicious traffic as needed. Most of the suspicious traffic is usually incoming, but if there is an infected endpoint, outgoing traffic may also be infected. It may choose to drop traffic or even block the IP altogether if deemed malicious.

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## 10.8 Web Application Firewall (WAF)

Another common appliance protection that exists at the perimeter are the so-called WAFs. WAFs protect applications inside the perimeter in a distinct manner as compared to the firewalls described above. In fact, they normally sit after the firewall and filter traffic further after the firewall has done the first round of filtering.

Vulnerabilities exist for almost all softwares, and these are normally addressed by periodically patching, as will be described in Sect. 10.9. The most vulnerable in a three-tier architecture is actually the web application itself because it is the one that is exposed directly to the end-users and also normally, the one exposed to the Internet. Good coding practices are supposed to minimize security issues; however, this may not always be the case, and many companies can ill afford to take the application offline if such vulnerabilities are discovered. Patching is also another way to address some of these vulnerabilities, but immediate patching is not always possible. As such, the WAF acts as a first line of defense filtering malicious traffic before they reach the applications for application-level type of vulnerabilities. Typically, for

web-based applications, these vulnerabilities are those indicated by OWASP (2021), and are also among the main vulnerabilities addressed by a WAF.

Other vulnerabilities commonly addressed by WAFs include DDOS attacks (Kizza 2009), hacking by means of stealing unencrypted cookies, and the like. Normally, it also carries features such as CAPTCHA and the like to detect and block bots from accessing applications. Bots have become more and more relevant lately in cybersecurity, as they are commonly being used by hackers to automate repeated attempts at gaining access, or downing servers.

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## 10.9 Patching

One of the most important activities that can address vulnerabilities in applications and systems in general is regular and timely patching. This is common knowledge in the industry; however, the reality is that patching is often done haphazardly and not in a regular, methodical manner. Typical barriers are:

- Patching causes downtime and is not acceptable for IT operations, and even the business managers themselves—things must always keep running!
- Patching may require testing which is lengthy and time-consuming.
- There may be incompatibility with legacy systems or customizations made.
- Many OT (operational technology, meaning industrial control) systems really do run 24/7 without choice.
- Not knowing which patch is relevant, and which to deploy.
- Too many patches coming in!!

This brings about my next point which is that a policy is needed in order to patch. This policy really encompasses important aspects of patching which need to be decided a priori and not every time a patch is to be released. Among others, the following should be covered by the policy:

- What type of patches will be deployed—different policies should be defined depending on the patch to be deployed (e.g., security patches vs. new functional features).
- Periodicity.
- Person or team in charge of the patching.
- Servers, endpoints, and other devices affected.
- Schedule.
- Approvals: Which patches are pre-approved for release? Which patches will require approval?
- Testing, if needed.
- Roll-back procedure, criteria for the roll-back in case it fails.

Policies are designed to be implemented; they cannot be a mere piece of paper. The beauty of this is that even if the procedure for patching may be at first rebuffed,

once a policy is signed by the proper authorized management representatives, there is no backing out from it. A common precept that I abide for in IT security is (as mentioned in Sect. 10.2):

Do not implement a security measure without a policy; but  
Do not define a policy which you cannot enforce

The reason for the first, as I just illustrated, is that a policy will help in defining what is to be done, and once approved, will not be questioned, and will also avoid people from deferring making decisions. In this case, decisions that are very important for the well-being of the entire organization. The second statement above if followed however deters you from having a false sense of security, as well as increases your credibility in the eyes of the users since they know you are enforcing the prescribed policy.

If we go back to the contents of the policy framework defined above, it is obvious that it is impossible to patch manually once you have a significant number of servers and/or endpoints. It is also impossible to track manually the patches that are applicable to your environment, which brings me to an important point being that you need a patching tool and need to detect missing patches and then patch automatically for patching to be effective. Manual patching is insufficient patching. This is also the reason why standard applications and operating system baseline configurations should be used; otherwise, it shall be extremely difficult to patch so many differing versions.

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## 10.10 Hardening

There is no single definition of hardening (Australian Signals Directorate 2023), but here we shall define it as the removal of accounts, services, and features which may come by default with the softwares or hardwares, but are not actually needed in the manner that they are used in your particular environment and organization, or may be disabled to further secure your security posture by reducing the possible attack surface.

Take note that reducing the attack surface is a very powerful and a commonly used concept in IT Security. As we have said, all hardwares and softwares have vulnerabilities; it is just a matter of time before they are discovered. A software may be further broken down into services and components, each with their own possible vulnerabilities. By reducing the number of services and/or components used, you actually reduce the probability of a vulnerability affecting you, hence, you reduce the probability of attack (this is the so-called attack surface). Hardening is just that, reducing the number of components and services to what is either strictly needed, or reducing them even further to avoid attacks.

Take for example, an operating system. By default, it may come with RDP (remote desktop) enabled. RDP is a favorite of hackers because it would allow them to remotely control the server or endpoint in question if they can hack an account. By simply disabling it, one has actually improved one's security posture altogether.

Take another example which is a web browser installed by default in a server. Unless it is strictly needed by the server application to undertake some function (which is not usual), it can be uninstalled altogether, hence reducing the attack surface once more. Take note as well that if not removed, this is one more application that needs to be regularly patched.

Hardening also brings me to another important topic which is configuring baselines.

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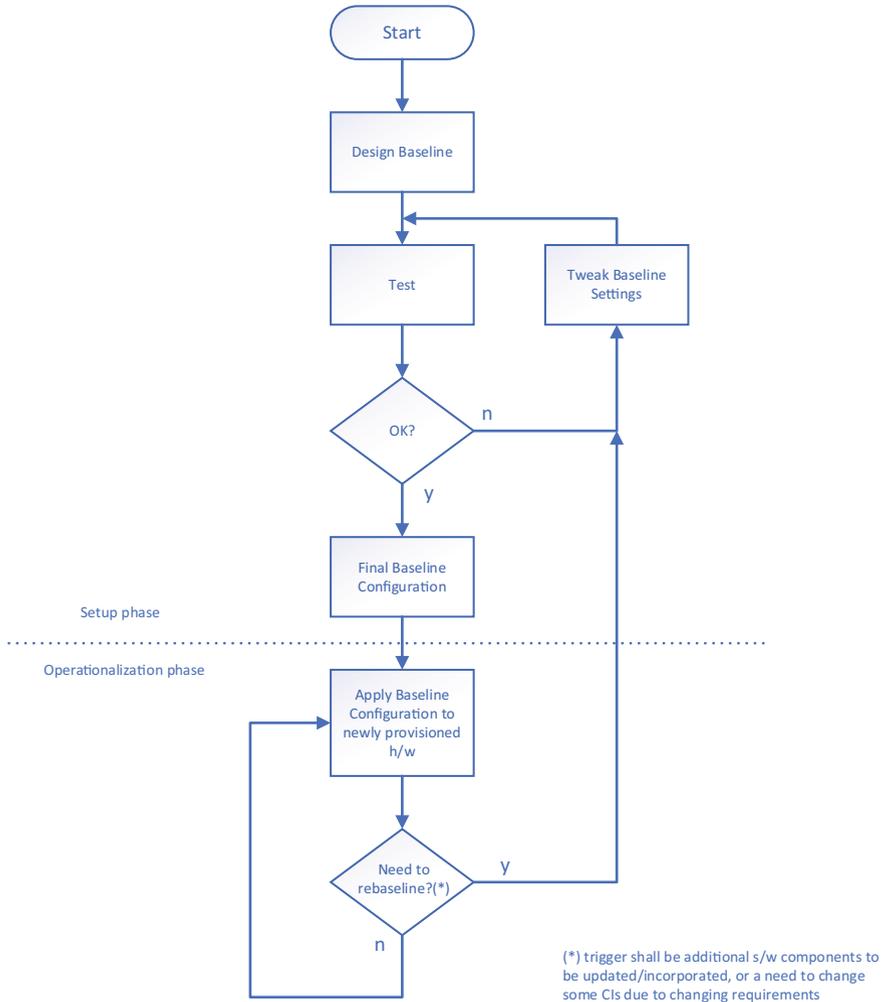
## 10.11 Baselining and Baseline Configurations

Another word with differing definitions is baseline, however, we will stick to a narrow use of it in this book. In this context, I shall refer to as baseline the pre-established and approved configurations for either servers or endpoints. In other words, they are a “copy” of the entire operating system, standard applications, and their corresponding default CIs that will be used in installing every newly provisioned server or endpoint. In other words, they contain the entire base setup for either a server or an endpoint. If the environment is virtualized, then a baseline copy of the virtual machine will serve for subsequent installations for new servers and endpoints.

Having a baseline has many advantages, not only from a security standpoint:

- Saves time in provisioning new servers and endpoints as there is no need to install everything from scratch, not only is this time-consuming, it is also error-prone.
- Baseline will contain “clean” copies of all the necessary applications to be installed. This includes the operating system itself.
- It also has all unneeded services and applications already removed or disabled, as was discussed in the previous chapter under hardening.
- All the proper configuration items (CIs) are already set up. Changes to this baseline CI configuration can be made for specific servers/endpoints, but will be minor as compared to doing everything ground up.
- If the baseline is properly updated from time to time, it shall already incorporate all the necessary patches.

Determining the baseline is the first step toward the proper management of the baseline configuration. This may take time if hardening is to be put in effect, as the first step would consist of listing all services enabled by default in the operating



**Fig. 10.7** Baseline management

system (especially) and standard applications even up to the version level, and determining if they are truly needed for most installations, or if they can be turned off or not installed altogether. Sometimes the effect of disabling a service may not be totally apparent and may thus require an iterative process of implementing-checking-tweaking-rechecking.

The general process for baseline management is shown in Fig. 10.7

Once the final baseline configuration is established, it can then be used for provisioning new hardware. Take note that several baseline versions may be needed as the CIs and software components may be different depending on where it is to be

applied. For example, a workstation used in an industrial facility will have a very different setup from that used in a corporate IT environment. Needless to say however, the number of baseline configurations should be restricted to a minimum; otherwise, it would defeat the purpose of baselining altogether, and will be a burden in terms of managing the different baselines.

The baseline however cannot stay static, it must be regularly updated due to:

- Patches
- New/decommissioned/upgraded softwares
- Updates in the services to be dis-/enabled and CIs
- Newly discovered vulnerabilities that affect the baseline

If new versions of O/S are released and are to be adopted, a new baseline for it will have to be created altogether. In the event that only an update is required, then the process at the bottom of Fig. 10.7 will then be applied, otherwise, one needs to start from the top.

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## 10.12 Proper Use of Admin Accounts

This is another topic which may seem obvious to the reader but which typically causes a lot of challenges in an organization. In general, the “least privilege” principle should be applied at all times. This means that only privileges strictly needed by the account holder should be given, and not more. Again, the principle is easy to understand, but not as easy to apply as the number of applications and users grows. Having a single sign-on (SSO) applied using Active Directory (AD) or the like will definitely help in its management as it gives a first level of access to the different applications. The least privilege principle is also one of the foundations behind zero-trust. But first, let us look at the challenge in implementing this principle.

Of course, the most obvious application of this principle is not giving admin privileges to non-admin personnel, however, even admin privileges come wide and varied. Firstly and the most powerful is the domain admin if you are using AD, which basically has access to the SSO and consequently, access to all the different applications running under that domain. Domain access should ideally be given to the administrators of the AD only. Then comes the admin for a particular application, as well as the local admin, which has access to the underlying operating system itself. There is no one rule that fits all for this, but again using the principle of least privilege, rights should be given only as needed and for a specific time period if possible. Let me illustrate this with an example.

Imagine that a certain application’s admin is in charge of giving rights within the application to different users as may be needed by them to undertake their proper functions, and this is the only function assigned to this admin. Therefore, he should not have any other rights (local admin, domain admin, etc.) beyond this and therefore

has no authority in, for example, installing additional application modules in that machine or updating the database version.

Another example is an external authorized party installing an application on a server, the account used for installation should be in accordance with policy (a service account usually), with sufficient rights to conduct the installation and for a limited, predetermined time only. Subsequently this account will either be locked out or its password changed when turned over to operations.

One other good practice is to separate the functions of determining user roles and rights in an application from the actual execution in giving those rights (i.e., separation of duties again). Normally the first is handled by the Application Management (AM) group, while the second is handled by the SysAd group. Under no circumstances should the same group determine user rights and be able to execute these, as there ceases to be any check and balance. Roles and rights may or may not need to be approved further by management once AM defines them and before SysAd executes, depending on the company's policy as well as type of access control as defined in Sect. 10.4. One needs to take into account as well that access control may not be a decision to be made by IT entirely but by the proper office. Take the very clear example of access to payroll, it may only be the Payroll Head to actually authorize such access, as IT would have no idea whatsoever whether the request is proper or not. Ultimately however, notwithstanding whatever access control mechanism is adopted by the company, the best manner in which to implement approvals is once more using the service desk system as explained in Chap. 4, this is because one can implement approval processes systematically (vs. discretionary) and would leave behind an audit trail which could be referred to later on. Even discretionary approvals can be captured by the SD, which may be needed in justifying actions undertaken by IT.

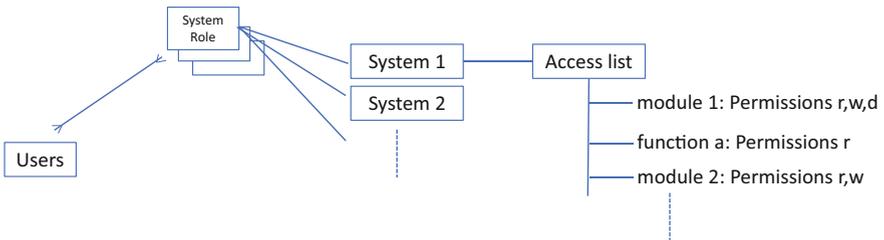
As an example take the case of a computerized maintenance management system. One good way to implement access is via the use of role-based access control (RBAC) which again means you assign rights only as needed by the *role*. Thus, the role of the user in the company organization defines what type of access he is to be allowed to use. RBAC roles are never static, they change with time, sometimes quite rapidly. RBAC can be implemented in diverse ways using automated tools, but at its simplest form, an excel can be used to track users-roles-access privileges. An example is shown in Fig. 10.8, herewith referred to as an access control matrix.

The enemy of RBAC or any nondiscretionary access control is the customization of roles and permissions to individuals. This is oftentimes done in organizations as it is fast, and yet, it is hard to manage which may lead to authorization creep or forgotten accesses that should have been repealed. One manner of avoiding this pitfall is for the team in charge of defining the access (AM) to always reference the access control matrix when endorsing it for execution. No execution should take place unless the access control matrix is used, with no assumed roles and authorizations, so that authorizations always start with a fresh role provision. In Fig. 10.9, we illustrate how an RBAC may be implemented, though there may be other ways:

Role	Transaction Code	Transaction Code Description	Create	Edit	View	Reverse
IT Admin	WCC4	WCM: No. Range Maintenance: WCNWAP	X			
IT Admin	WCC5	WCM: No. Range Maintenance: WCNWAPI	X			
IT Admin	WCC6	WCM: No. Range Maintenance: WCNWDCOC	X			
Master Data Mgt	CL6BN	Object List			X	
Master Data Mgt	CR06	Work Center Assignment to Cost Ctr			X	
Operation User	CV01N	Create Document	X			
Operation User	CV02N	Change Document		X		
Operation User	IB80	Change Documents for Equipment BOM			X	
Operation User	IB81	FuncLocation BOM Change Documents			X	
Maintenance planner	IW34	PM Order for PM Notification	X			
Maintenance planner	IW36	Create PM Sub-Order	X			
Maintenance planner	IW37	Change Operations		X		

User Name	Complete Name	Department	Role
USER1	JOE HUNT	PLANNING DEPT	Maintenance planner
USER2	PATRICIA KONG	PLANNING DEPT	Maintenance planner
USER3	WALTER PEAK	PRODUCTION	Master Data Mgr
USER4	HAROLD LEE	OPERATIONS	Operation User
USER5	MARK JOHNSON	MAINTENANCE	Maintenance planner
USER6	THIEN BE	MAINTENANCE	Maintenance planner
USER7	LARRY BIND	IT	IT Admin
USER8	JOSE PADILLA	OPERATIONS	Operation User
USER9	TIMOTHY QUEENS	IT	IT Admin
USER10	ANDREW MCCULLOG	PLANNING DEPT	Master Data Mgr

**Fig. 10.8** Access control matrix: matrix above shows the different roles and their access and authorization; the matrix below is a sample of several users whose role given is based on their position in the organization



**Fig. 10.9** Possible hierarchy setup for RBAC

- System roles are defined and users may be attached these roles based on their role and position in the company. A user may be assigned different system roles.
- A role may be defined for a single system or application, or may span different systems, as in the example shown.
- For that particular system and role, an access list will define the type of access the role has, such as for particular modules inside the system, particular functions, or even particular data.

In general, the broader the definition of each of these components is, the easier it is to manage. The shown hierarchy may be further refined according to one’s need, such as the geographical location of the user, or the assets to be accessed (e.g., particular warehouse), etc., but the general idea remains.

As we know the Internet is basically unsecure, therefore, another best practice is for administrators not to have Internet access when using their privileged Admin account. If Internet access is needed (which commonly is), then a separate, less-privileged account should be used which will allow them to access the Internet. This diminishes the risk of something malicious going straight into their privileged account which will later on infect whatever applications and servers they subsequently access.

### 10.13 Defense in Depth

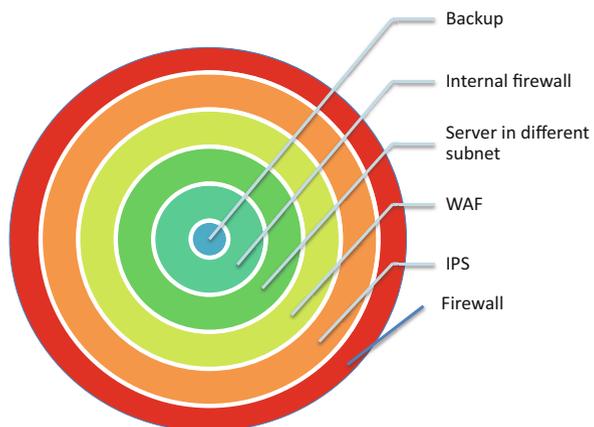
Oftentimes, IT Security has several challenges, including:

- Lack of sufficient budget
- Delays in addressing vulnerabilities due to operational constraints
- Solutions not being 100% foolproof

The first challenge is really about awareness by management on the importance of IT Security; the last two, however, need to be addressed using some security strategies. In the same way that software is never 100% secure and eventually shows some vulnerability, the same can be said of IT Security tools; they may not always address an underlying concern due to misconfigurations, loopholes, and overlooked or inherent flaws in them. Furthermore, IT Security tools are designed to address specific security issues, but threat actors use a combination of techniques to circumvent, escape detection to attain their ultimate goal.

In summary, one cannot rely on a single protection for one's environment, and must think of additional protections in case the primary protection fails. To take a page from military strategy (U.S.NRC 2021), the idea is to make use of the concept of "defense in depth" wherein the asset being protected is encircled by multiple layers of protection as shown in Fig. 10.10. An attacker must not only breach one

**Fig. 10.10** Defense in depth concept (illustrative example only)



protection but must breach multiple layers for him to reach his final target. The probability of that happening decreases exponentially as the layers increase, unless, of course, one is unaware of another entry point which is less (un)protected. In case one layer fails, there is a subsequent compensating layer to address the issue.

Another concept taken from the military is that even though the defenses may be breached eventually, having so many layers delays the attacker from reaching its target, which gives the organization enough time to react, contain, and stop the intrusion. This is particularly true if the organization is using an SIEM (security information and event management) tool (Microsoft 2023a) or XDR (extended detection and response) (Microsoft 2023b) which in turn are monitored either by an in-house or outsourced SOC (security operations center) team. Both SIEM and XDR monitor endpoints, servers, networks, and other IT assets by capturing logs and traffic, which are then sent to a security analyst team, or a SOC for monitoring and interpretation. These tools have underlying pattern recognition and correlation capabilities (using ML or AI typically) in order to flag suspicious activity to the SOC. The SOC ideally would be 24×7 so that any suspicious activity occurring at any moment can be investigated and acted upon.

In the example shown in Fig. 10.10, imagine the scenario wherein an Internet-based attacker is aiming to penetrate your secure perimeter to reach a server. Each of these protections, firewall, IPS, WAF, etc., is an additional protection layer before the attacker reaches the server. See that the ultimate protection in the end if everything else fails is to have a clean backup which will restore the system to its original secure form, more of this to be discussed in Sect. 10.14. Bear in mind that the figure here is just an illustrative example, and not a recommendation.

Take note, however, that the example cited that of an attack coming from the Internet is just one of many attack scenarios which need to be taken into account. The layers shown above will not be all the same if, for example, the attack is perpetrated within your intranet, or an endpoint has been compromised due to malware; hence, different scenarios need to be considered with different defense in-depth layers identified for each case. It is important as well to understand how breaches and attacks are currently being undertaken, as these change with time.

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## 10.14 Backups

Backups were already discussed in Sect. 4.5, but from the point of view of security, it pertains to the restoration of a system to a previous state due to a faulty release, or as a disaster recovery measure. In the same way, hacking, intrusion with its possible dire consequences such as ransomware (wherein your data is encrypted by the hacker and becomes inaccessible), or simply wiping your data clean or corrupting the application/data with malware may be considered disasters, and the same principles of disaster recovery apply. Remember that not all backups are the same; it is important to understand what can be recovered from the backup when and if your system is attacked. The point of restoration of the backup will also be based on the latest clean backup which was made (recovery point).

With regard to clean backups, an important aspect of this is to keep backups offline so as to prevent them from getting hacked as well. This is an important consideration since the price of disk has gone down so significantly that many companies are switching to disk or even cloud instead of tape backup. Regardless of the setup, an “air gap” is needed to prevent the hacking from affecting one’s backup, otherwise, restoration will be of no use because the backup itself may have been compromised. Tapes are not the only way to achieve this air-gap capability, but is currently the most practical and cost-effective solution. A tape rotation strategy must be designed and executed, so that from time to time, the backup tapes are taken offline and placed in a different secure, physical location. The frequency for this would depend on how much a data loss time the organization can afford to lose, in accordance and agreement with the affected business stakeholders.

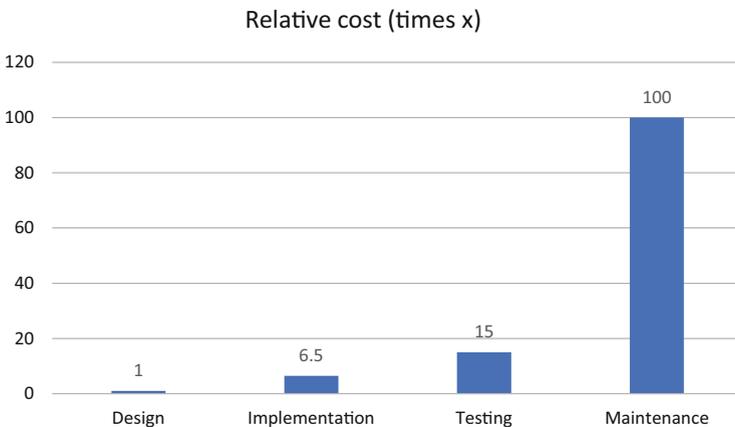
It is also a best practice to test the restoration process, and even simulate possible downtime scenarios that could reflect reality, so that no surprises are encountered once there is a need to execute these.

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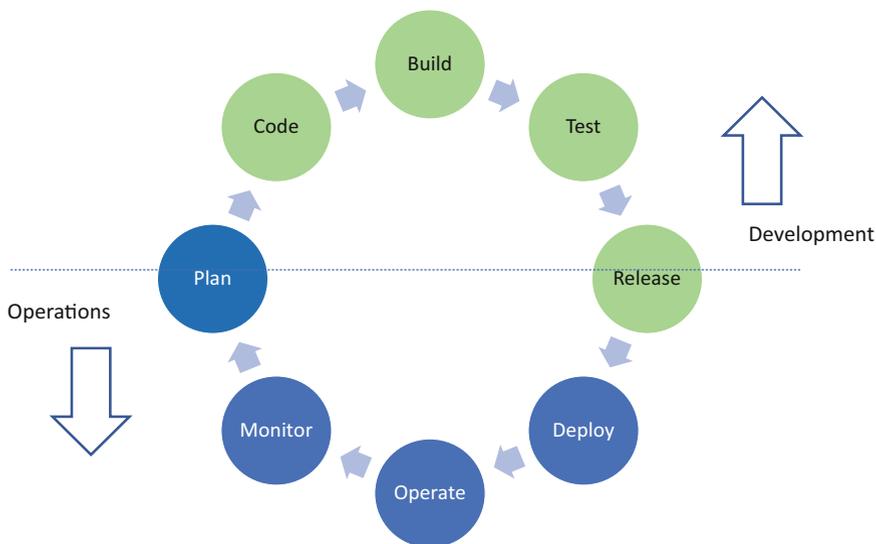
## 10.15 Secure Coding Practices

One of the basic principles in IT Security is that the further into production a vulnerability remains undetected, the more expensive and disruptive it becomes to fix. Refer to Fig. 10.11 as reported by IBM’s System Science Institute (IBM System Science Institute 2010) in which a bug (or vulnerability) fixed during implementation (coding) is about 6.5× more expensive than if fixed during the design phase, while one detected during testing is 15× more expensive to fix, while it would be 100× more expensive to fix once in production during its maintenance phase.

In other words, the earlier one detects and addresses the vulnerability, the better. If the organization is developing its own code for either building a complete



**Fig. 10.11** Showing the relative expense of a software defect depending at what stage it is found



**Fig. 10.12** Typical secure software development lifecycle

application ground up or inserting the code in a COTS in order to customize some functions, it is best to be aware and adopt secure coding practices.

The first step to do this is to prepare specific guidelines and disseminate these secure coding practices to the development team so that they code accordingly. As a best practice, the software development lifecycle (SDLC) adopted by the organization should contain specific guidelines on how to ensure the code being produced is secure, this is commonly referred to as secure SDLC (SSDLC). Several SSDLC models exist (AWS n.d.; itHoot 2021) but in essence have similar steps. For our purpose, I have chosen a generic model which illustrates the concept as explained in Fig. 10.12. Not only should the SSDLC model incorporate all the necessary security guidelines, it is also imperative that the guidelines be as practical as possible so that they are easily understood by the team and be implementable.

Let us discuss its different phases briefly:

1. **Plan**—in which the overall structure, components of the software are defined at a high level, including its different interfaces with other modules or applications, as well as the overall architecture, O/S, DBs, and other infrastructure components that would define how the software will work. At this stage, known vulnerabilities need to be addressed in terms of the components being utilized (DB, O/S, libraries, etc.) and, if needed, revamped or patched.
2. **Code**—this would include the gathering of (user) requirements for the software, analysis, and its development (coding). At this stage, secure coding practices need to be taken into account.

3. **Build**—in which the executable is put together from all the component codes and compiled into a working software. Code review should be conducted before the build, in which a peer or external party (definitely not the person coding) reviews the code for compliance, and white box testing tools will also be used at this to scan it for vulnerabilities, while not waiting for the final build.
4. **Test**—in which aside from the regular functional testing, also automated white, gray, and black box testing tools are run for compliance (as explained further below).
5. **Release**—the software, once it has passed testing, is then released to production.
6. **Deploy**—released software is now available for use by the different users. If on the cloud, it is now accessible for download or direct use.
7. **Operate**—in which the O&M team now operates and maintains the application, including determination of further requirements.
8. **Monitor**—for performance or additional vulnerabilities. Vulnerabilities evolve with time; thus, what was secure during the initial release may not be secure anymore at this stage. Regular scanning using automated tools needs to be done. If a new version needs to be developed, the whole cycle starts again from the planning stage.

If Agile methodology is used, then consider using DevSecOps principles as explained in Chap. 8. DevSecOps aims to reduce the pushback from the Operations and Security teams in placing code in production due to security concerns. In summary, it involves both Operations and Security teams early on during the pre-development and development phases of the SSDLC so that once the code is to be released, it has already passed the inspection of both Operations and Security teams.

Using the principle of PDCA explained in Sect. 10.1, one cannot instantly assume that the code coming out from the development team is secure, and must be checked. Again, the PDCA applied to our concern means that first the code is planned and designed according to secure principles, then developed, checked, and finally tweaked to address underlying vulnerabilities, the cycle repeating itself again thereafter. The checking part can be done using either one or a combination of the following general techniques:

- **White box security testing**—wherein the source code is made known to the tester and is inspected for vulnerabilities.
- **Black box security testing**—code is not disclosed; hence, the “black box” is tested by injecting different scenarios which typically expose the application to known vulnerabilities.
- **Grey box security testing**—is a combination of the above two in which the inner code structure is partially known, adding value to the black box testing technique.

Black box testing is the easiest to automate, as it will just present several scenarios to the application and test if these are processed correctly. Gray box testing can make such scenarios more focused based on an understanding of how the “box” or

application is built, making the scenarios more relevant. Depending on the testing tools, these may actually test for OWASP compliance (OWASP 2021) or checks for versions of the software components and checks if these are the latest, patched versions and if not, may flag the corresponding vulnerabilities. Other scan types may also exist.

The most primitive type of white box testing will consist of manually reviewing the code, however nowadays, more and more capabilities of white box testing are being automated. White box testing is however less straightforward as it requires for specific test scenarios to be defined by the user, based on his knowledge of the code on hand.

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## 10.16 Security Awareness

An often cited and abused concept is the saying that “IT Security is not the sole responsibility of IT but of the entire organization including its users,” while this is true, making the users really responsible, aware, and actually participative in security endeavors is usually easier said than done because putting this into practice is really not easy.

If one were to break down the different stages of user awareness, the following would apply:

1. **Ignorance**—no understanding at all on what are some of the threats the user may face, nor best practices in the secure use of IT
2. **Aware**—in which some basic understanding of threats and good practices exist
3. **Practitioner**—in which the user is very much aware, updated on threats and practices secure IT usage at all times
4. **Advanced**—aside from being a practitioner, takes the time to read and understand the evolving threat landscape and adopts best practices accordingly
5. **Expert**—which not only has an advanced level but proactively teaches and guides other users on these, as well as actively coordinates with IT on concerns

It generally takes time to evolve from stage 1 to 5, and this doesn’t happen by itself, but through a medium- and long-term program designed and targeting that evolution. Definitely not all users will be experts, but the idea is that a select group of users will have the motivation and interest to become experts so that the entire organization benefits. In general, this can be done via:

- IT Security training sessions
- Organization within the company of IT Security user groups that will promulgate and serve as an extended arm of the IT Security core group.
- Awareness campaigns via email, videos, reminders, and the like.
- Phishing simulation and retraining – as phishing remains the #1 method for penetrating and hacking organizations and is virtually impossible to eliminate

without proper user awareness and behavior, then this is a critical part of the training and awareness.

- Strict enforcement of IT security policies whenever they seem to be breached or if users fail in the awareness campaigns and training.

IT Security professionals in many companies complain about the lack of interest and awareness of users in IT Security; however, this is normal and the main responsibility to elevate the awareness falls fully and squarely on the IT Security team. The common problem is that IT Security professionals often are disconnected from reality, churning out complicated IT and technical terms which the common user does not understand. It is necessary for the IT Security team to use laymen's terms in describing how things work and, even more importantly, what the user should do and should not do, and how to detect threats and attempts without having to incur complicated technical descriptions. Also important is to know when they should escalate and report things, and to whom. In summary:

- Describe the security threats using simple language
- Identify clearly the user do's and dont's
- Teach them how to quickly identify suspicious activities, links, and emails
- Clearly identify to whom they need to report any suspicious activity or who they can ask for support from
- Continuously refresh and retrain users

More than the above can of course be done, but these are the basic premises. To illustrate an example of how to bring IT Security to the masses, take this scenario in which the IT Security Head plans to explain the difference between a secure Wi-Fi connection to a web application, and an unsecure one. He may come up with the following guidelines:

- Inspect if your Wi-Fi is encrypted.
- Non-encrypted Wi-Fi and those using TKIP and WEP encryption are not considered secure either.
- Make sure that the security certificate of the web application you are accessing is valid.

The above recommendations, while entirely true, raise more questions than answers to common users and will end up in them not using these guidelines at all. A better sample of how the guidelines may look like could be something like this:

- Never use public Wi-Fi if financial transactions or confidential information is being transacted. Office Wi-Fi is certified to be secure, your home Wi-Fi's security would depend on how you have set it up (consult the manual or a qualified technician), use these preferably.
- When accessing websites that ask for financial information, personal information, or any other such confidential information, make sure that the website is secure. You may check this by ensuring it is using valid https credentials:

- The website will appear with an `https://` prefix on the browser bar at the browser's top.
- A lock symbol will also appear, indicating that the website and its connection are secure.
- No warning that `https` is disabled, or anything concerning a faulty security certificate should appear on your browser screen.

One of the main reasons for educating and involving the users is that no matter how much technical safeguards are poured into IT Security, one aspect that cannot be solely addressed via technology is user behavior, which is in fact what social engineering hacking techniques take advantage of. Nothing can stop a user from clicking a link, plugging in an infected USB, opening an email attachment, or connecting via an unsecure Wi-Fi connection. Yes, it is true that technical safeguards can and should be put in place to minimize any untoward effect that these may have, but they will never be 100% foolproof.

Just as important is for the users to know where to inquire for further assistance if they detect suspicious activity, as well as to report confirmed suspicious activity, or detected vulnerabilities. This will make them feel that they are not alone in terms of security and that they can rely and depend on experts for this matter. This of course means that the organization being consulted is really prepared for this function. Going back to the O&M table of organization of Fig. 3.5, the best suited to handle these initial inquiries is, as usual, User Support, and concretely, service desk, for initial assistance. Service desk and field support should be trained into the basics of IT Security (which should easily handle 80–90% of queries) and trained on how to escalate, if needed. They should also have the ability to:

- Inspect emails for phishing, spoofing, and spam.
- Block and blacklist emails, domains, and IP addresses if needed.
- Inspect websites and check their legitimacy and reputation.
- Block and blacklist confirmed suspicious websites.
- Analyze any reported virus and malware detection.
- Escalate signatures to the antimalware and antivirus vendor for their inclusion.
- Other miscellaneous items which they can act on.
- If action requires further inspection or more sophisticated actions, then they will escalate.

One very important aspect is for US to detect if their actions are enough to remediate the threat, as well as whether the threat spans more than just one user's concern and may be a bigger threat to the organization. In case of the latter, the incidence response system should be triggered.

## 10.17 Incidence Response

Threats are constantly present in the IT Universe and are constantly attempting to penetrate and disrupt one's operations, however, a threat has a long way to go before it becomes an incidence. there are ways of classifying security threats depending on the degree in which they have infiltrated in an organization, for example, from lowest to highest infiltration and risk, the following classification may be used:

- Vulnerability
- Event/threat
- Incidence
- Breach or hack

Let us define each briefly. Vulnerability is a known weakness in your architecture, software, or system that may be used by an attacker to bypass protection mechanisms designed to protect based on the CIA triad and its extension as described in Sect. 10.3. This means that it has the potential to be exploited, but may not necessarily have been exploited yet by threat actors. Vulnerabilities are regularly reported by software vendors (for their own software) by releasing patches and by security firms and organizations which monitor these.

A security event is one in which there was an intended or unintended attempt at breaching one's IT Security policies. Usually an event is flagged, addressed (automatically in most cases), and reported. If deemed to have been stopped at this point and poses no further risk to the organization, then the investigation and remediation process may stop here. It is nevertheless important to monitor and report these in order to ascertain that the risk has indeed stopped there and also, to check if a targeted attack is taking place, in which your organization has been singled out and attacks are consistently being delivered, not always in the same fashion, in order to cause a breach. If either situation is detected or if the security event has not been fully addressed, then it may now be classified as a security incident.

A security incident carries much more risk vs. a security event, even though it may initially have been classified as an event. It requires a deeper analysis to determine:

- What is its effect
- Has it been addressed fully so far and if not, what should be the next steps in order to do so
- How did it happen, and how did it manage to breach current defenses
- What needs to be done so as to address such breaches in the future

Of course, the most immediate concern would be to understand the first two points, but eventually an understanding of the circumstances leading to the security incident needs to be analyzed in order for it to be really fully addressed, as well as to avoid a repeat situation.

There are some very important aspects when dealing with a security incidence:

- Understanding and having objective criteria on when a security event becomes an incident.
- Who needs to be informed of the security incidence, either for their knowledge only, analysis, mitigation, or remedial action. There may be several teams involved upon escalation, and those may not only be from the IT department.
- When a security incidence can be closed.
- Who has the authority for each of the statuses described above.

The way incidences are to be handled depends on the nature of the incidences and the company itself; no two companies handle incidences in the same way. As such, an Incident Response playbook needs to be drafted and approved by management, which will detail all of the above steps, processes, and approvals, in a very concise, nonambiguous manner. Most importantly, the workflow will define the incidence response of the organization. It is very important to note that such a playbook and workflow should not only involve IT but also other departments, because incidence response is (again) a responsibility of the whole organization. If, for example, a breach does eventually happen, other departments may need to get involved in order to mitigate the effect of the breach in terms of impact and even company reputation. As an example, if credit card information is breached and taken by an attacker, the retail operations group together with the corporate communications dept. may need to work together in order to inform the public, regulatory agencies, etc.

On the other hand, the playbook needs to be practical. Take for example, the possibility of a company's informational website taken down due to a DDOS attack which is remediated after 1 h. Should the company formally announce externally that it has been attacked? To whom and in what manner? Who makes this decision? Is it worth reporting externally?

The last and worst level of infiltration is of course a breach. All IT Security professionals dread that possible outcome and will devote their utmost effort in avoiding this last stage due to the disruptive nature of such a possibility. Needless to say, sufficient thinking and effort should have been placed in coming up with a defense in depth strategy so that the probability of this occurring is really very small. In the worst of cases also, a recovery procedure shall be ready and called in for this purpose. Part of the incidence response playbook will of course contemplate this scenario, and typically, specialized qualified resources will be called for (sometimes externally) in order to assist in its permanent remediation. Of course, remediation at this point is many times more expensive than addressing the issue at any earlier stage.

---

## 10.18 The Convergence of IT and OT

Operational technology (OT) refers to the different systems used in managing equipment at factories and shop floors, commonly referred to as industrial control systems (ICS). They normally work autonomously of the IT network and are pre-programmed to execute their function with minimal human involvement, mainly

controlling equipment such as motors, valves, heaters, and pneumatic and hydraulic systems, among others. Traditionally OT systems were separated from IT systems via an air gap in which neither was physically connected to the other. Today, the convergence of IT and OT is a reality because more and more, management wants to know what is happening at the factory level, not perhaps at the detailed level in which OT systems provide information, but yes in terms of summarized, up-to-date reports and analyses (production details, downtime, availability, etc.).

This has catalyzed the convergence of the two, so that communication between the OT's ICS to the IT systems and network (primarily in this direction) is now demanded for. To do this securely, it must be architected correctly (see Brandl (2008) for some more information on the ANSI/ISA95 standard), and many other concepts beyond this book need to be taken into account. In general however, many of the security concepts of IT need to be applied in OT, albeit in their own manner given its own particular needs. Revisiting the extended CIA framework of Sect. 10.3, one can immediately appreciate that the requirements in IT differ significantly from that of OT.

The most important aspects in an OT environment always center around safety; it is primordial to always protect personnel from physical injury and, secondly, equipment from breakage. Confidentiality does not usually come up high on the list as OT is really controlling machinery, and there is very little data other than operational data in OT systems, which usually is not of very big interest to hackers. Availability is naturally high in the list as the lifeline of the plant is to keep on running without any unplanned interruption. In the same way, integrity of the data and, especially, configurations are required so that availability, safety, and access are properly ensured. Lastly, access is very important as it also affects all the other aspects indicated above. Unfortunately, access to industrial systems is usually more basic; MFA, single sign-on, and use of DNS are limited at best due to legacy reasons.

As cybersecurity spans both IT and OT, any attempt to separate their responsibility entirely will not work cohesively. Hackers do not differentiate between IT and OT, if both are interesting to penetrate. The most usual way for hackers to penetrate the OT and ICS layer is in fact via IT, precisely because IT is connected to the Internet and the ICS is not (and should not!). From the IT network, the attack will start jumping devices until it is able to land in the OT network, creating havoc there. Of course, one should also protect the OT against internal attacks.

For the above reason, the best practice is to have a common, integrated view of cybersecurity under one person and team, which in turn can prescribe and execute policies for both areas, taking into account how they interact and are interconnected. This however does not mean that policies will be the same for both areas, as evidenced by the priorities listed in Table 10.1.

To illustrate what I mean by this, imagine endpoint protection installed in both IT and OT workstations, wherein the endpoint protection has the capability to scan and/or block USB devices inserted into them. Depending on the policy chosen by the company, it may choose to allow USB devices for IT laptops, wherein the endpoint policy is one of "Scan USB and automatically delete malicious files from it," while

**Table 10.1** IT vs. OT cybersecurity priorities

Security aspect	Area	
	IT	OT
Confidentiality	High	Low
Availability	High	Very high
Integrity	Very high	Very high
Non-repudiation	High	Low
Access	High	Very high
Safety	N/A	Very high

in the ICS network, USBs may be disallowed altogether and blocked. The same tool may be used for both, but clearly the policies will differ in each.

## 10.19 Conclusions

In conclusion, IT Security is an important field touching absolutely all aspects of IT and even OT, and thus, a basic understanding is needed for all IT professionals. It is also fast-changing, and so what may be secure and sufficient practices today may be unsecure and insufficient tomorrow.

This chapter aims to make a basic understanding of IT security simple and practical, as there is too much information in this field, but little in the way of explaining basic principles and layman's understanding. If the reader is interested in delving further in this field, he is encouraged to refer to the bibliography, as well as the large amount of information available on the Internet.

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## VM (Virtual Machine) Backup Solution

### 1. Company Profile

XXX

### 2. Background

XX

All applications were virtualized using XXX which started 2012 and completed by 2013. Backup and restore procedures were implemented using XXX Backup but mainly for file and database backup and recovery only and this does not include the entire system backup of each and every virtual machines which is also considered essential to business continuity process.

The proposed VM Backup Solution should focus on the following criteria:

1. Backup speed;
2. VM image consistency check after backups;
3. Multiple restore capabilities;
4. Point-in-time recovery;
5. Replication to complement colocation strategy for disaster recovery;
6. Data deduplication to reduce backup storage requirements;
7. The ability to target any storage device.

Below is the identified number of VM Host with their respective number of CPU Sockets that requires implementation of VM Backup Solution.

Site	# of servers	# of CPU sockets per server
Data Center	2	4
	8	2
Head Office	9	2
Remote Sites	15	2

### 3. Objectives

This Request for Proposal aims to achieve the following:

- Ensure that the proposal meets the requirements stated in the Scope of Work.
- Ensure compatibility with our current systems.

To fulfil the above objectives, the Bidder is expected to bring experience and expertise in the area of implementing backup solutions for virtualized environment.

### 4. Scope of Work

The scope of the project includes the following:

- 4.1 Implementation and configuration of all needed software Solution proposed should be all-inclusive and not require any additional hardware, software or services aside from those in the vendor's proposal, for the solution to function. Off-the shelf software and hardware may be purchased separately by the company, so that their corresponding costings should be itemized separately.
- 4.2 All hardware will be provided by the company, the bidder should include all hardware specs for Development, QA/Testing and Production environments, whichever are relevant to the project.
- 4.3 Creation of detailed implementation plan to include the duration of the project and number of resources.
- 4.4 Provide user and administration training that covers Installation, configuration and management course for three (3) participants.
- 4.5 Complete documentation of the project including user manuals, training manuals, presentations, and source code (wherever applicable).
- 4.6 Post-implementation support and maintenance.

### 5. Submission of Proposals

The company reserves the right to:

- Reject any or all offers and discontinue this RFP process without obligation or liability to any potential vendor,

- Award a contract on the basis of initial offers received, without discussions or requests for best and final offers, and
- Consider all responses to this TOR as binding, and have them form part of the contract
- Disqualify and/or blacklist any vendor due to misrepresentations or misinformation provided in the proposal.

Vendor's proposal shall be submitted in the format as set forth below. Responding service providers will confine its submission to the matters sufficient to define its proposal and to provide an adequate basis for the company evaluation of the Vendor's proposal.

The proposal should contain three parts:

### 5.1 Company Profile

5.2 Client references—references with similar products/services provided including description of what was provided.

### 5.3 Cost and Technical Proposal

5.3.1 Technical Proposal—the technical proposal should be limited to ten (10) pages + appendices with the following information:

5.3.1.1 General Description of the proposed solution.

5.3.1.2 General description of the base software of the proposed solution (e.g. web services, portal software, etc.), if any. This may be complemented with an exhaustive description of the solution architecture with detail work flows in an Appendix (soft copy only is acceptable)

5.3.1.3 Project Timeline—Detailed schedule of activities and identified deliverables per activity. Please use MS Project 2010.

5.3.1.4 Methodology—should describe the general methodology to be used in the project implementation with description of concrete activities to be undertaken, including expected involvement from the company's personnel (if any).

5.3.2 Relevant credentials (e.g. Gold Partner, etc.)

5.3.3 Project Team composition with detailed CV's of assigned key personnel including information on project implementation experiences, at least 3 years relevant experiences, similar to this project and roles. Supporting Training Certifications should be provided.

5.3.4 Cost Proposal—the cost proposal should be detailed per component.

5.3.4.1 If discrepancies occur between the total cost and itemized costs, the company shall make use of whichever price is lower.

5.3.4.2 Price quoted should be inclusive of ALL TAXES except VAT. Price quotations that indicate otherwise will be assumed to include all taxes or risk being disqualified.

Example:

Component	Unit cost	Metric	Amount (VAT Ex)
Software licenses			
Backup software		Per VMHost	
		Per Core	
		Per VM	
Services			
Installation/configuration			
Others (If any)			
Total cost			

**Prepared By: XXX**

**Endorsed By: XXXX**

## Annex: List of Functional Requirements

Item	Requirements	Comply (yes/no)	Remarks/Work Around Substitution
1	Backup and replication solution in a single product		
2	Leverage vSphere API (Application Programming Interface) for Data Protection.		
3	Integrate and leverage on Changed Block Tracking.		
4	Agentless deployment without the need to install individual agents inside each Guest VMs.		
5	Full support for VMWare ESX and ESXi editions.		
6	Ability to backup via vCenter or directly from individual ESX or ESXi servers.		
7	Support for LAN-free data backup.		
8	Support for thin and thick provisioned VMs.		
9	Provide a centralized web-based enterprise console to monitor and manage all the backup servers with dashboard statistics view.		
10	Ability to add datastore object as a dynamic container for backup which will includes new VM when it is added into the datastore during backup job run.		
11	Ability to exclude specific virtual disk for backup as per VM selected in a backup job.		
12	User profiling to allow role segregation to perform full administration, backup operations, backup viewing only or restore operations.		
13	Customizable block size for optimal deduplication across different network (SAN, LAN, WAN).		
14	Deduplication and compression bundled in software without additional option to purchase.		

(continued)

Item	Requirements	Comply (yes/no)	Remarks/Work Around Substitution
15	Ability to utilize forward and reverse incremental backup methodology.		
16	Ability to utilize full backup methodology		
17	Ability to provide application-consistent backups (utilizing Microsoft Visual Source Safe or VMware Tools).		
18	Support for continuous job schedule to immediately start the backup job once upon completion to provide near-Continuous Data Protection (CDP).		
19	Backup VM can be manually or automatically removed from the backup image file to reduce backup storage space.		
20	Single, consistent method of image-level backup but provides granular full or item-level recovery.		
21	Ability to perform full VM restoration and Guest OS file-level recovery		
22	Ability to perform application-item level recovery (for MS SQL, MS Exchange, MS Active Directory and other applications).		
23	Ability to perform transaction log pruning after successful backup of VM running MS SQL.		
24	Automated verification of backup images by starting up required VMs, checks performed on VM, OS and Application to ensure integrity without the need of human intervention. Verification report to be emailed automatically to administrator can be configured.		
25	Provide near-CDP-level replication bundled in software without additional option to purchase.		
26	Ability to create isolated environment for on-demand Sandbox with required VMs running for testing/troubleshooting. In addition, this isolated environment will be able to interact with the production environment.		
27	Offsite storage of backups with built-in WAN acceleration.		

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